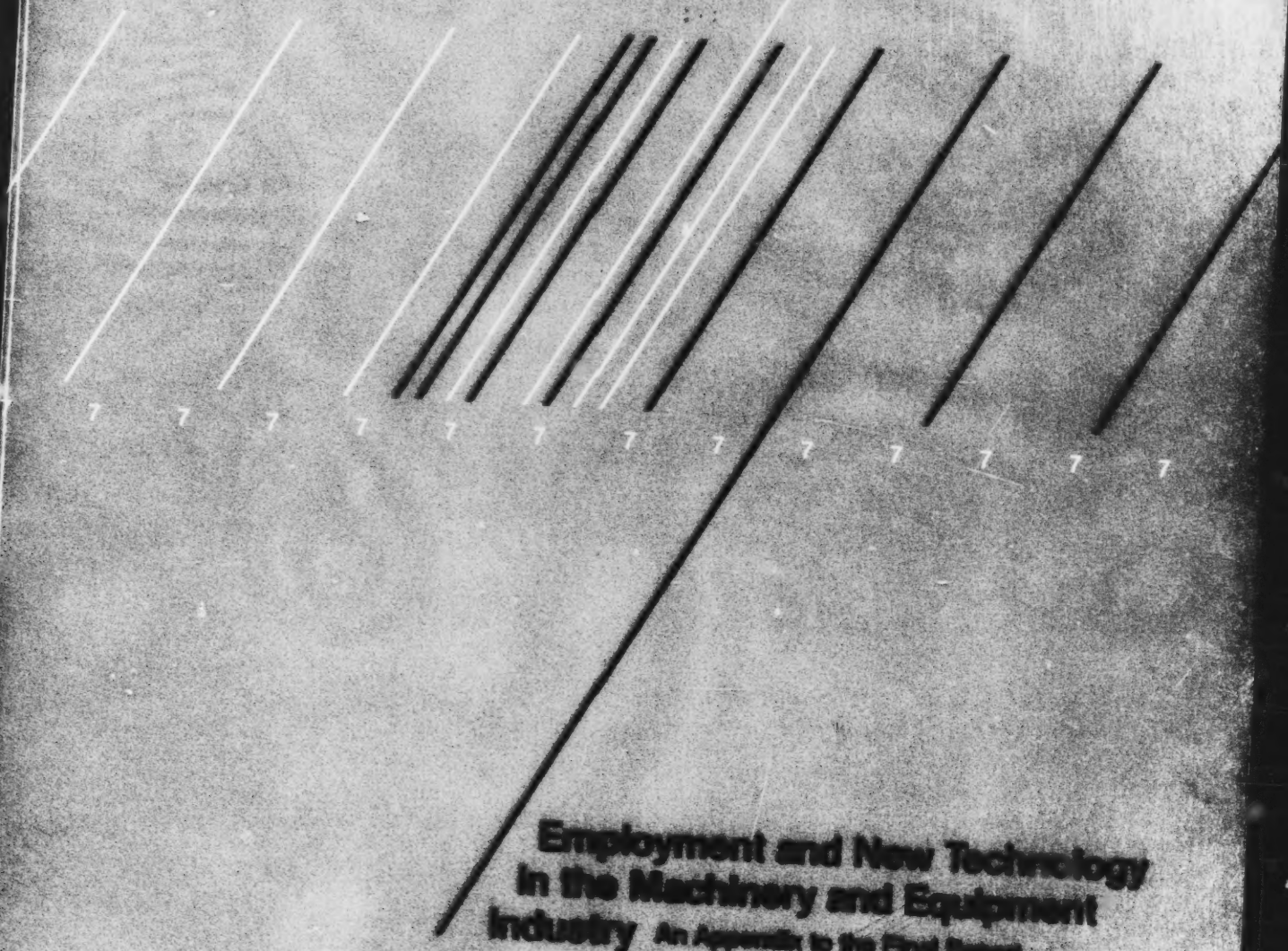
The Ontario Task Force on Employment and New Technology



Employment and New Technology in the Machinery and Equipment Industry

An Appendix to the Final Report

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ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

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APPENDIX 7

EMPLOYMENT AND NEW TECHNOLOGY IN THE MACHINERY AND EQUIPMENT INDUSTRY

This Appendix contains a report prepared for the Ontario Task Force on Employment and New Technology. The topic was approved in advance by the Task Force. At the conclusion of the study, the Task Force had the opportunity to review the report but its release does not necessarily imply endorsement of the results by the Task Force or its individual members.

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FOREWORD

The Ontario Task Force on Employment and New Technology, a joint labour-management group, was established in May 1984 "to consider and report on the manpower and employment implications of new technologies as the same may be introduced and applied in Ontario during the next decade and the extent and nature thereof."

To inform its discussions, the Task Force established a research agenda designed to gather information on employment and technological change from a wide variety of sources. The research agenda contained projects which gathered information of a historical nature, and projects with a future orientation which were designed to gather information describing likely occupational and employment implications associated with technological change in the 1985-1995 period.

The Appendices to the Final Report of the Ontario Task Force on Employment and New Technology contain reports of these research projects. A complete list of these Appendices may be found at the rear of this document.

Among the Appendices are reports of a series of studies to assess the extent and nature of the employment implications of new technology in selected industries in Ontario. Appendix 3 describes the process by which the industries were selected, and contains the studies' terms of reference which called for particular attention to selected new technologies and occupational groups. Appendices 4-18 contain reports of these industry studies, which were conducted by Currie, Coopers & Lybrand, management consultants.

This particular appendix contains a report of the study on the Machinery and Equipment Industry.

Dr. Richard L. E. Brown, P.Eng.
Research Director

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The Task Force would like to thank the staff of Currie, Coopers & Lybrand, particularly Maureen Farrow and Victor Rocine, whose assistance in the conduct of this study was greatly appreciated.

Special thanks are due to all industry experts and survey respondents who provided information for this study.

EMPLOYMENT AND NEW TECHNOLOGY IN THE MACHINERY AND EQUIPMENT INDUSTRY

A Report Prepared by Currie, Coopers & Lybrand
for the Consideration of the Ontario Task Force
on Employment and New Technology

July, 1985

Submitted By: Maureen Farrow
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EMPLOYMENT AND NEW TECHNOLOGY IN THE MACHINERY AND EQUIPMENT INDUSTRY

PART I - INTRODUCTION AND METHODOLOGY

1.0 INTRODUCTION

This report is one of a series of industry reports which summarize the findings of a major research project[1] undertaken for the Ontario Task Force on Employment and New Technology. Each report includes a historical analysis and an outlook to 1995 for the industry, and a review of the anticipated impacts of new technology on employment.

1.1 Structure of This Report

This report presents the study findings for Ontario's Miscellaneous Machinery and Equipment Industry (SIC 315)[2]. The report includes four parts.

- The first part (Chapter 1.0) is the Introduction which includes a description of the approach and methodology.

- The second part (Chapter 2.0) is a Historical Analysis for the industry from 1971 to 1984 which provides background and a perspective on the industry's historical development.

- The third part (Chapters 3.0 to 7.0) discusses the results of the survey of firms in the industry and incorporates the interview findings with industry experts. These chapters cover:

  - a review of recent and anticipated technology adoptions,

[1] Manpower and Employment Implications of New Technologies in Selected Manufacturing Industries in Ontario to 1995. The terms of reference of this assignment can be found in Appendix 3 to the Task Force's final report.

[2] 1970, Standard Industrial Classification (SIC), Statistics Canada.

- the outlook for the industry to 1995, including expected output and employment levels,

- effects on employment of new technology such as anticipated occupational shifts and changes in required skills,

- a review of the labour relations environment as it relates to new technology, and

- observations on planning efforts for technological change in the industry.

- Part four of the report includes various appendices that support the text of individual chapters.

1.2 Study Approach

The study approach selected incorporates the following research techniques:

- analysis of published statistics and reports on the industry, augmented by the working knowledge of industry specialists within Currie, Coopers & Lybrand,

- in-depth interviews with management and labour experts in the industry, conducted at various stages in the project, using structured interview guides, and

- an industry survey.

The reasons for the choice of these techniques are explained below.

1.2.1 Historical Analysis

The purpose of the historical analysis was to provide an informed perspective on the industry from which to view future trends. The historical analysis covers: the economic environment, competitive factors, output and employment patterns, productivity, technology adoption and the industrial relations environment. In order to permit cross industry analysis, consistent indicators and data sources were used.

1.2.2 Expert Interviews

At various stages in the project, a series of in-depth interviews were conducted with industry leaders, industry associations and union representatives. These experts have a broad understanding of the industry in terms of both its historical development and its future outlook. Their input assisted in the preparation of the historical analysis and in the survey design, and facilitated a clearer interpretation of the survey results.

1.2.3 Sample Survey of Firms

The following describes the key features of the survey.

Ontario firms in the Miscellaneous Machinery and Equipment Industry were identified using the 1982 Census of Manufacturers.[1] All firms with twenty (20) or more

[1] Manufacturing Industries of Canada: National and Provincial Areas, 1982, Statistics Canada, Catalogue No. 31-203.

employees were included in the sample frame. Employment in these firms is estimated to include 99 percent of the 36,904 employees (1982) in the Miscellaneous Machinery and Equipment Industry in Ontario.

There were 262 firms in the industry in 1982 with 20 or more employees. This group of firms, with twenty or more employees, was the base for selecting a sample of firms for the survey. Table 1 shows the number of firms[1] in the sample frame, by size.

A representative random sample of firms, stratified by employment size categories (see Appendix A), was chosen from the sample frame. The senior executive officer of each firm was identified and a structured questionnaire was sent to this individual.

A search was carried out of the Ontario Ministry of Labour Collective Agreements Library to identify unions in the sample firms. Union head offices were contacted to identify the appropriate union leader in each of the unionized firms in the sample. The same questionnaire was sent to union representatives. A copy of the survey questionnaire is attached as Appendix B together with an outline of the number of responses by question.

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1 The number of firms should not be confused with the number of establishments (717 in 1982). Establishments are production centres. Therefore, a firm may have more than one establishment.

Consultants provided ongoing assistance to respondents, both on the telephone and in person, to complete the questionnaires. The questionnaire survey process generally ended with a personal interview. The number of firms and unions who participated in the sample survey are shown in Table 1, below.

TABLE 1: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

Firms by Employment Size	Number of Firms and Unions Responding By Firm Employment Size: Firms	Unions	Firms in Sample Frame (1)
Small (20-99)	3	0	178
Medium (100-499)	7	2	76
Large (500+)	2	1	8
Total Firms	12	3	262

(1) SOURCE: Statistics Canada, CENSUS OF MANUFACTURERS, 1982.

In most cases, several participants in each organization contributed to the completion of a questionnaire. In the Miscellaneous Machinery and Equipment Industry survey, an average of 1.1 participants contributed to a firm questionnaire and 1.0 participants to a union questionnaire. The companies' principal participants had an average of 15 years' experience with their firms and 22 years in the industry. The unions' principal participants had an average of 20 years experience both with their firms and in the industry.

The sample survey results have been weighted up to the number of firms in the sample frame. That is, the survey results reported herein refer to the weighted survey results and are, therefore, representative of firms with twenty or more employees in the Miscellaneous Machinery and Equipment Industry (SIC 315) in Ontario. Reliability of the sample is estimated at 99 percent with a 5 percent allowable error. See Appendix C for an explanation of the sample reliability calculation method.

Readers should be cautioned about the nature and reliability of the sample survey results. The questionnaire included a set of questions asking respondents about the future (i.e., five and ten years ahead) from a particular point in time. The results are, therefore, a representative sample of views about, and expectations for, the future and should not be viewed as what will necessarily take place. The survey provides a useful perspective from which to better understand how the industry perceives the future of new technology adoption and its anticipated impacts on employment.

The next chapter of the report discusses the historical analysis and subsequent chapters review the results of the sample survey and expert consultation which discuss the anticipated trends for the period 1985 to 1995.

PART II - HISTORICAL TRENDS 1971-1984

2.0 INTRODUCTION

This section of the report provides an historical analysis of trends in the Machinery and Equipment Industry for the period 1971 to 1981 and 1982 to 1984. The machinery and equipment industries in Ontario include 717 establishments that shipped products worth $3.1 billion in 1982 and employed 36,904 people. Ontario accounted for 61 percent of Canadian shipments (in 1981) and 53 percent of establishments. About 50 percent of production is exported, mainly to the United States.

2.1 The Structure of the Industry

The machinery and equipment industries produce a very wide product range, shown in Table D.1 in Appendix D. One third of these products are sold to the resource industries - forestry, pulp and paper, oil and gas, and mining. Another third of these products are sold to manufacturing and processing industries as the basic equipment used in the production process or to perform ancillary tasks such as packaging and materials handling. The remainder includes a wide array of equipment used throughout the economy. In every case, these machinery products are an essential input to the production process. This means that the industry is an important conduit transmitting new technologies into primary and secondary industries in Canada.

The machinery and equipment industries in SIC 315 are defined in such a way that they exclude electrical equipment, farm machinery and transportation equipment. However, establishments primarily engaged in manufacturing industrial tractors for handling materials in industrial plants, depots and docks are included here. Included also are establishments primarily engaged in manufacturing woodworking machinery and in manufacturing machine tools which are power-driven machines employing a cutting tool for work on metal. Establishments primarily engaged in

manufacturing bits, drills and other cutting tools for machines or for power-driven hand tools are not part of SIC 315 but are included elsewhere.

The industry includes a large number of firms - but most product lines are dominated by relatively few firms (six to ten). The larger firms are predominantly foreign owned, while the small firms, which include numerous family owned machine shops, are Canadian owned. Many of the small firms have managed to carve out a market niche, and those that have adopted new technologies such as computer-numerically controlled machine tools (CNC's) have shown remarkable growth in recent years despite the hard times in the industry.

These small firms and even the large Canadian owned firms are highly dependent on technology purchased from abroad either through licensing arrangements or by buying an advanced type of machine which gives them high levels of precision and quality in their own products.

Large machinery producers tend to sell a diverse product line, rather than concentrate on supplying one industry such as mining or one type of machinery. Most of the large firms are foreign owned. They have been set up in Canada for three reasons:

- to satisfy local content requirements.
- to reduce transportation costs.
- to provide local repair, rebuild and replacement services, a highly profitable aspect of the business.

Foreign owned firms rely heavily on the original designs and the ongoing research and development of the parent company. In some cases, the Canadian plant is limited to a true branch plant role, acting as an assembly operation, while all the sophisticated

manufacturing activity is undertaken by the parent. Such firms have no in-house R&D capability and no mandate to sell in export markets.[1] However, the majority of foreign owned firms have some autonomy in terms of product development and export capability and many of them have a world mandate for a particular product.

Table D.2 provides a listing of selected machinery makers in Ontario.

2.2 The Market Environment

Markets for machinery and equipment are international and highly competitive. Japan and West Germany dominate high technology machine tool production. They took over from the United States in the 1970's because it was slow to adopt new technologies and pursue overseas markets. However, this is an industry where individual firms in other countries, such as TVW Paper Machine Group Ag of Finland, manage to maintain a strong position in specific markets because they offer a particular design and maintain a reputation for good quality. In recent years, there has been a surge of new entrants to the market from countries such as Spain, Portugal, Brazil, Taiwan and India. Their primary motivation at the time of start up was to displace imports into their domestic market, but they have also begun to show up at international trade fairs in order to promote exports.

The key determinants of success in the international market are design (which incorporates technology), quality and price.

- Design development in new machinery and equipment is now dominated by the application of computers to mechanical

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1 One study showed that 45 percent of Canadian subsidiaries producing mining equipment are free to export, while 55 percent are restricted in some manner. Of these, 15 percent are not permitted to export at all and 25 percent only with Canadian export financing. See Canadian Department of Industry, Trade and Commerce and Regional Economic Expansion, A Profile of the Mining Machinery and Equipment Industry in Canada, March, 1982, p.14.

devices. The most advanced flexible manufacturing systems incorporate a series of modules where a robot will perform complex and highly precise tasks. The robot can change tools, set up and complete the task automatically. The job of the operator is to do the programming and apply the software. The computer is pervasive in metalworking, in process controls (such as pulp and paper), in materials handling and in all sorts of special industrial equipment. To be competitive, Canadian firms must, in the first place, adopt these new uses of technology in their own production process, but, secondly, they must also offer their customers a range of products that incorporate leading edge ideas so that the customer can compete effectively. While all the developments in this industry are described as evolutionary, the pace of evolution has sped up to the point where third and fourth generation models are just a few years away from the original model.

- Quality of the final product is essential in the machinery industries because the company buying machinery does not want to face excessive breakdowns and repair costs. When breakdowns occur, a manufacturer must provide prompt repair services. This gives a special advantage to big firms with a reputation for reliability and the capacity to perform repairs.

- Price has become more important than ever in recent years because the world-wide recession has created excess capacity. Large firms are, therefore, prepared to cut prices in order to increase the flow of work through their under-utilized plants.

The state of the technology in a plant can have an impact on both price and quality because the most advanced equipment can achieve speeds and degrees of precision which have never been achieved by earlier combinations of manpower and tools.

One key constraint in international competition is the proliferation of barriers to trade. The United States Buy America Act, for example, creates a barrier to imports. And countries compete through the type of export financing they offer firms bidding on export orders. William L. Mallory, President and Chief Executive Officer of Ingersoll-Rand Canada Inc. has praised Canada's export assistance as "superior to that of any other industrialized nation" and "important to manufacturing industries because of the limited market for most products".2

The Canadian market for machinery is not large enough to justify a full range of manufacturing facilities. Firms are forced to specialize in a certain area and to supplement their domestic sales through exports. As a result, exports have accounted for about 46 percent of total shipments in 1983. At the same time, there are many types of machinery and equipment that are not supplied by Canadian firms. Imports accounted for 66 percent of domestic consumption of machinery and equipment in 1983.3

The degree of specialization has been rising over the past 15 years, with both exports and imports growing rapidly. There are many firms who imitate trends in design; their relative success in the marketplace is determined to a considerable extent by the speed with which they do the imitation. There are a few firms, however, who are at the leading edge. Firms who make packaging machinery for consumer products industries have developed a new generation of high-speed equipment that has been in great demand in the current business expansion. They exported 90 percent of their production to the United States in 1983.

Ontario machinery makers are ahead of their counterparts in the rest of Canada in the adoption of new technologies. The 1984 census of the use of advanced technologies in Canada published by

2 The Canadian Business Review, "Getting the Machinery Industry on Track", Winter, 1983, p.17.

3 Machinery and Equipment Manufacturers Association of Canada, based on Statistics Canada data.

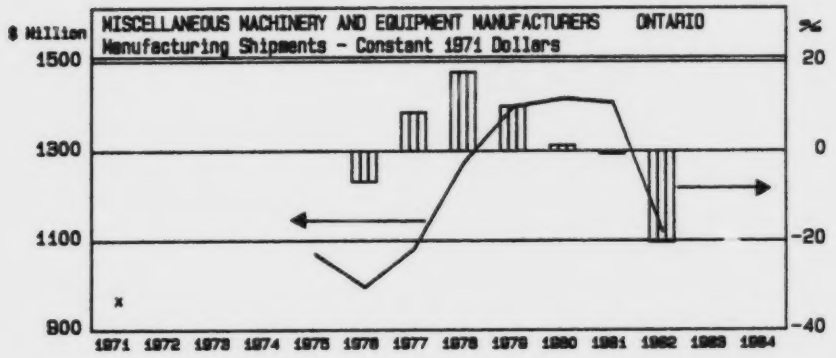
Canadian Machinery and Metalworking in March, 1984 showed that 73 percent of Canadian establishments have NC machine tools in place and only 8 percent have CAD/CAM installations. Ontario firms are over represented in these figures. For example, Ontario accounts for 53 percent of all establishments and 63 percent of those with NC machine tools. (Table 2.3).

2.3 Industry Trends

Tables D.4 to D.7 present the key industry indicators for the years 1971 to 1984. These tables are presented in Appendix D, Historical Tables.

2.3.1 Aggregate Output

EXHIBIT 1



x 1971. Intervening years 1972 to 1974 not available. For explanation, refer to Table D.6.

In 1971, manufacturing shipments of the miscellaneous Machinery and Equipment Industry in Ontario were $957.3 million. By 1981, manufacturing shipments had increased to $3.6 billion in current dollars. In 1982, manufacturing shipments declined to $3.1 billion. (Tables D.4 to D.7).

In constant 1971 dollars, manufacturing shipments increased from $957.3 million to $1.4 billion over the 1971 to 1981 period. Real shipments therefore, experienced an average annual rate of growth of 3.9 percent over the period. Average annual growth in shipment activity was more subdued in the early 1970's than in the latter half of the decade. From 1971 to 1976, volume shipments averaged an annual growth rate of 0.8 percent. By contrast, in the period from 1976 to 1981, real shipments climbed rapidly, averaging an annual growth rate of 7.2 percent in Ontario.

The reasons for this pick-up in shipment activity in the latter half of the decade included the following developments:

- The primary reason was a surge in the number of large scale energy projects, particularly the so-called mega projects such as the Syncrude tar sands project in Western Canada, the Beaufort Sea project in the Canadian Arctic, and the James Bay hydro electric project in Quebec. This sharp increase in energy investment in the mid to late 1970's was spurred by the OPEC oil embargo and the oil price increases of 1973 and 1974 and 1978 and 1979. Stronger oil prices and the threat of world oil shortages provided the incentive for investors to explore and develop higher risk ventures, in particular, the Arctic frontier. At the same time, the Canadian government was encouraging a new thrust to become energy self-sufficient.

  The Canadian Petroleum Association Statistical Handbook shows that the average number of metres drilled in Western Canada from 1970 to 1975 was 4 million per year. In the period from 1975 through 1983, activity had almost doubled to average 7.6 million metres drilled per year. These statistics do not include the frontier activity in the Canadian Arctic which came on stream in the late 1970's and which caused a further increase in exploration activity levels.

The Royal Bank Review also indicates that energy driven investment in plant and equipment as a percent of GNP more than doubled from 3 percent of GNP in 1975 to 7 percent in 1982. At the same time, non-energy driven investment fell from 12 percent of GNP in 1975 to 6 percent in 1982. Thus, even while total investment as a percent of GNP declined, energy investment was increasing its share of the investment dollar in the late 1970's and early 1980's.

Ontario's Machinery and Equipment Industry was a key supplier of the energy exploration and development projects. These projects had significant machinery and equipment requirements. Exploration of the Arctic required that entire islands of machinery and equipment be constructed and assembled. Much of this equipment was supplied by well established Ontario manufacturers because the Western provinces did not have the diversity of manufacturers nor the capability to satisfy local projects' needs. As well, the Ontario Machinery and Equipment Industry was strategically well located in terms of the nuclear reactor and hydro electric projects coming on stream at this time. Although such projects as the hydro electric development at James Bay and the construction of the Bruce A nuclear reactor required vast amounts of electrical equipment which are not included in SIC 315, these projects also required construction machinery, boilers, heat exchangers and turbines which are included in SIC 315.

- Another key reason for the increase in machinery and equipment shipment activity in the late 1970's was an increase in the proportion of machinery and equipment investment while structures oriented investment by Canadian corporations remained relatively flat. Business investment in machinery and equipment increased from 6.6 percent of Gross National Expenditure (GNE) in 1971 to 8.1 percent in 1975, as measured in constant dollars. Then, business investment in machinery and equipment as a percent of GNE remained in the 7.5 to 8.5 percent range from 1976 through

1980 before peaking at 8.8 percent in 1981. Meanwhile, structures oriented investment, or construction activity, remained relatively flat through the 1970's in the 11.3 to 11.9 percent of GNE range.

The reasons for this increase in machinery and equipment investment included an increasing interest on the part of manufacturers to use existing capacity more efficiently and improve profitability at a time of soaring labour costs by investing in productivity improvements and efficiency gains. At the same time, the pulp and paper industry in Eastern Canada embarked on a modernization and upgrading program that was supported by federal and provincial government funding. Meanwhile, the introduction of new mining machinery and equipment encouraged mining companies to invest in more efficient methods and processes to remain internationally competitive. Most important of all, however, was the increased number of large scale energy projects which required vast amounts of machinery and equipment investment, as opposed to structures-oriented investment in plant and buildings. As a result, machinery and equipment began to attract an increasing proportion of the total investment dollar by the early 1980's.

In the years 1981 and 1982, manufacturing shipments of machinery and equipment manufacturers in constant 1971 dollars fell off dramatically. Constant 1971 dollar shipments declined from $29.8 billion in 1980 to $28.5 billion in 1981 to $24.5 billion in 1982. Two factors played an important role in this decline in activity:

- First was the slump in energy exploration and development activity following the announcement of the National Energy Program in October, 1980 and its legislation one year later. The National Energy Program forced the cancellation of many mega energy projects and delayed the introduction of others.

The effects of the legislation were not fully felt until 1981 and 1982 because of the lags caused by slow recognition of the implications of the new legislation and the inability of exploration and development companies to withdraw their commitments immediately - most finished drilling during the 1980-1981 season despite the announcement of the National Energy Program.

- Secondly, the 1981-1982 economic recession caused a severe decline in investment activity generally as Canadian corporations weathered the most difficult market conditions since the 1930's. Most companies were forced to reduce their debt loads in the face of soaring interest rates and reduced profitability. As a result, capital investment programs were postponed or cancelled entirely.

  The resource sector was particularly hard hit by the 1981-1982 recession and the drastic decline in world commodity prices. Sales of machinery and equipment to the mining sector fell at this time, and were helped only by select ongoing projects such as the Northeast coal developments in British Columbia and gold exploration projects in the Hemlo district of Ontario. Machinery and equipment sales to the forestry industry also fell off with the squeeze on forestry producers profit margins despite the fact that the federal-provincial government modernization programs in Eastern Canada continued through March, 1984.

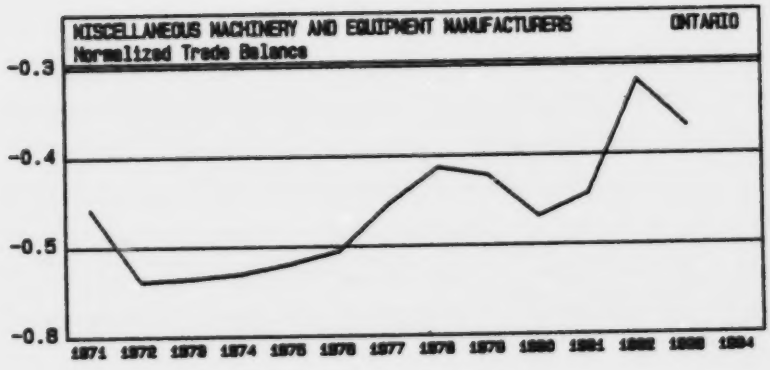
  Likewise, the manufacturing sector cancelled investment projects in the face of low capacity utilization and the weak profit picture. Like many resource companies, manufacturers closed money-losing operations, thus freeing up machinery and equipment for use elsewhere. As a result, the market for used machinery and equipment became buoyant at the expense of the original equipment manufacturers. The market for service and repairs also flourished at this time.

2.3.2 Competitive Position

Since 1971, the value of Ontario imports of miscellaneous machinery and equipment has exceeded the value of exports by at least a two-to-one ratio and, in five out of the last thirteen years, imports have exceeded exports by a three-to-one ratio. The normalized trade balance (exports minus imports divided by exports plus imports) has however been gradually trending upward, indicating that Ontario's negative trade balance as a per cent of total trade has been declining.

Ontario's normalized trade balance reached a peak in 1982, albeit still at negative levels. In 1983, a 5.4 per cent decline in the value of exports combined with a 6.3 per cent increase in the value of imports caused a decline in Ontario's normalized trade balance from the peak 1982 level.

EXHIBIT 2



The performance of Ontario miscellaneous machinery and equipment manufacturers can be compared to their counterparts in the United States based on value added per dollar of labour. A declining ratio indicates that labour has become an increasingly large portion of value added.

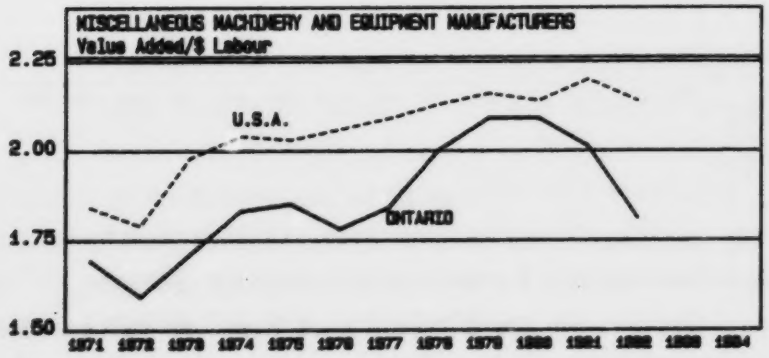
By implication, an increasing ratio indicates that capital has become an increasingly large portion of value added.

Exhibit 3 below illustrates that value added per dollar of labour has been gradually trending upward in the miscellaneous machinery and equipment manufacturing industry in the United States. In Ontario, value added per dollar of labour has been significantly less than in the United States since 1971. As well, value added per dollar of labour has followed a much more volatile path in Ontario than in the United States. In particular, value added per dollar of labour fell off more sharply in Ontario than in the United States following the general economic slowdown of 1974-1975 and the economic recession of 1981-1982. These sharp declines in the ratio reflect the combination of two forces:

- Firstly, the weak performance of the industry in Ontario during these periods of slow growth and, by implication, declines in constant dollar value added, and

- Secondly, a less than proportional decline in labour costs during these periods because of lags in recognizing and adjusting to the slow growth environment.

EXHIBIT 3



Machinery and equipment manufacturers have been slow to react to the difficult economic circumstances of the mid 1980's. Heavy, custom engineered machinery and equipment manufacturers, having suffered the most from the slowdown in shipment activity, have been forced to close operations and lay off employees. Other manufacturers have seen some improvement in capacity utilization during 1984 based on a recent pick-up in machinery and equipment investment in select areas of the economy; however, staggering government deficits have renewed fears of interest rate hikes and perpetuated an attitude of uncertainty that has limited the flexibility of machinery and equipment manufacturers to adapt to current market conditions.

As well, although the Canadian Machinery and Equipment Industry has substantial import replacement potential, Canada still imports over 60 percent of its machinery and equipment requirements. Thus, the Canadian and Ontario industry has been slow to benefit from a turnaround in the machinery and equipment investment climate. The benefits of the recent turnaround have accrued at least in part to foreign manufacturers.

Despite the weak performance of the Ontario manufacturers in terms of import replacement, local manufacturers have been able to sustain themselves based on service and repair expenditures. The proximity on Ontario based machinery and equipment manufacturers to the industrial heartland of Canada has allowed this industry to capture a large percentage of this ongoing business over the past several years. However, service and repair expenditures are not sufficient to cover the overheads of the larger Ontario based manufacturers.

2.3.3 Capital Investment

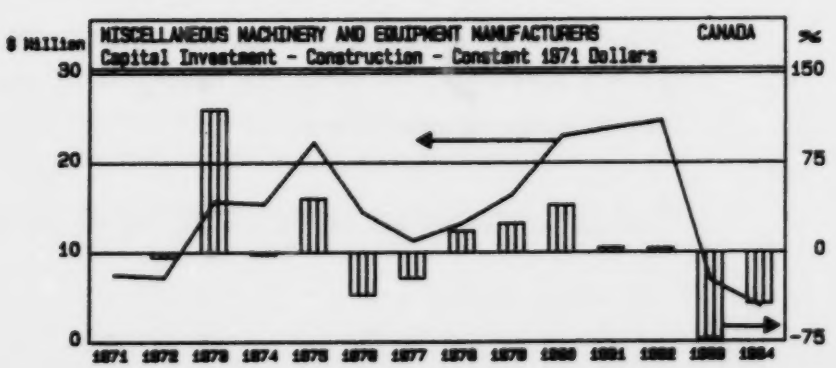
Capital investment statistics are only available for Canada as a whole for SIC 315; however, in 1982, Ontario based manufacturers of miscellaneous machinery and equipment accounted for 60.3 percent of Canadian shipments of these products.

From 1971 to 1981, total capital investment by miscellaneous machinery and equipment manufacturers increased from $36.1 million to $182.0 million in current dollars or from $36.1 million to $74.6 million in constant 1971 dollars. These increases translate into an average annual growth in constant dollar total capital investment of 7.5 percent from 1971 to 1981 (see Tables 2.4 to 2.7).

From 1982 to 1984, total capital investment of SIC 315 declined from $186.2 million to an expected $96.0 million in current dollars or from $70.3 to $33.7 million in constant 1971 dollars.

Looking at the period from 1971 to 1984 as a whole, capital spending in constant 1971 dollars by miscellaneous machinery and equipment manufacturers rose to a temporary high in 1975 before declining gradually through 1977. Spending then turned sharply upward again in the late 1970's reaching a peak for the decade in 1980 and then fell off drastically during the early 1980's.

EXHIBIT 4

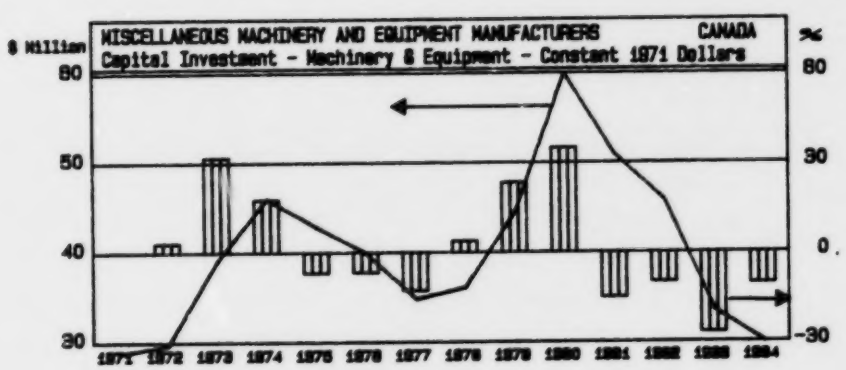


Capital investment on construction has traditionally been considerably lower than that on machinery and equipment for SIC 315. Capital investment on construction increased from $7.4 million to $58.9 million from 1971 to 1981 while the corresponding numbers for machinery and equipment were $28.7 million to $123.1 million.

In constant 1971 dollars, capital spending on construction increased at an average annual rate of 12.4 percent from $7.4 million in 1971 to $23.8 million in 1981. Meanwhile, spending on machinery and equipment increased at an average annual rate of 5.9 percent from $28.7 million in 1971 to $50.8 million in 1981.

In the period from 1982 to 1984, capital spending on construction declined in constant dollar terms from $24.6 million to $3.8 million. Capital spending on machinery and equipment also declined in constant dollar terms, from $45.7 million in 1982 to $29.9 million in 1982 to $29.9 million in 1984.

EXHIBIT 5



The pattern of capital spending activity was consistent for both the construction and the machinery and equipment components of total capital spending except that construction spending reached a peak somewhat later (in 1982, compared to a peak in 1980 for machinery and equipment spending) and the fall off in activity was more substantial for construction than for machinery and equipment. In 1984, capital investment by machinery and equipment manufacturers is expected to decline once again for both the construction and machinery and equipment components.

The cyclical nature of capital spending in the 1970's and early 1980's can be explained by the performance of the industry through the decade. In particular, the boom in spending in the late 1970's is explained by the vast machinery and equipment requirements of the mega energy projects and the capacity expansion and modernization programs of manufacturers to meet these increased requirements. Likewise, in the early 1980's, the decline in capital spending activity was dictated by the low capacity utilization rates and the high debt burdens of machinery and equipment manufacturers operating in a weak market environment.

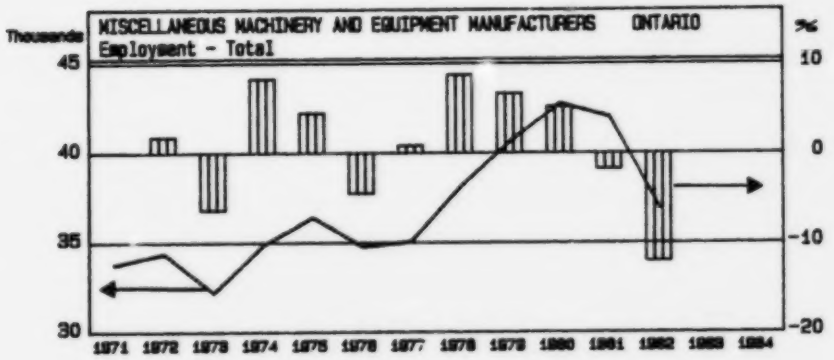
2.3.4 Employment

The discussion of historical employment trends includes an analysis of aggregate trends and occupational changes.

- Aggregate Trends

In this report, two sources of employment data are used in order to provide the level of analysis required. Total employment trends are taken from Statistics Canada, Manufacturing Industries of Canada: National and Provincial Areas, Cat. No. 31-203. This data series is based on the Census of manufacturing industries conducted by Statistics Canada annually. This data series is used as it shows the year to year trend in total employment. In order to analyze the employment trends by occupation the Census of Canada has been used. However, this data is only available for the census years 1971 and 1981. These two series differ because of differences in coverage and methodology and this should be noted.

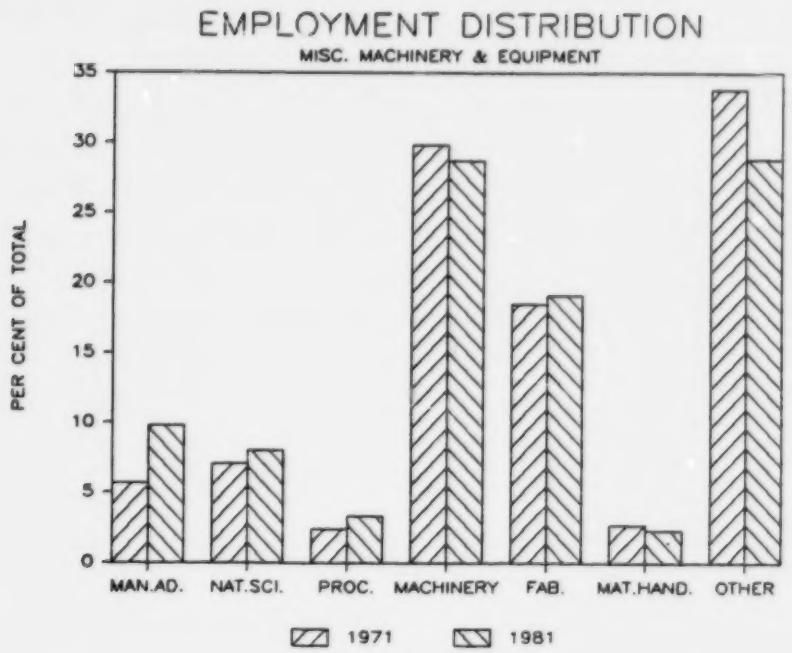
EXHIBIT 6



Total employment in the Machinery and Equipment Industry increased steadily through the 1970's at an average annual rate of 2.2 percent between 1971 and 1981. Employment fell off significantly in 1982 with a drop of 12.0 percent. In 1982, the Machinery and Equipment Industry employed 36,904 persons in Ontario compared to 33,738 in 1971.

- Occupational Changes

EXHIBIT 7



Census data for the Machinery and Equipment Industry in Ontario indicates that total employment increased by an average annual rate of 3.5 percent from 1971 to 1981. The broad occupational groups of Material Handling and Machining and their related occupations both grew more slowly than the industry rates, at 1.6 and 3.1 percent per annum on average as shown in Table D.8. This indicates the growing use of process type technology in reducing labour inputs at the production and loading stages. In contrast, the Processing and Managerial, Administrative and Related occupational groups grew at a rate well above the industry average, at 6.6 and 9.2 percent annually from 1971 to 1981.

An analysis at the more detailed occupational level indicates that the fastest growing employment categories were in Managerial, Administrative and Related occupations. Management occupations in Natural Sciences, Engineering and Mathematics, financial management and personnel and industrial relations managers experienced average annual increases in numbers employed of over 20 percent from 1971 to 1981. Nonetheless, the Managerial, Administrative and Related group as a whole accounts for only 9.8 percent of total employment so increases in terms of numbers of new jobs were small compared to other occupational categories.

Growth in the Machining and Related occupational group (which employed 12,000 people in 1981) was close to the industry average, but there was a wide variation in growth among specific skills. Declines were experienced by the machine tool operators and the filing and grinding occupations. The fastest growing occupations in the Machinery group included sheet metal workers, machinists, inspectors for metal machinery and tool and die makers.

The Other group, over 60 percent of which consisted of clerical workers in 1981, declined proportionately over the decade.

The analysis by sex in Table D.9 shows the greatest increase in female employment as a percent of total employment occurred in the Managerial, Administrative and Related group, followed by Product Fabricating, Assembling and Repairing, with 500 and 335 additional positions created respectively over the 1971 to 1981 period.

Results of Question 3

TABLE 2: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

SIC 315

Percent of Firms Planning to Adopt New Technologies by Employment Size (1)

Technologies	Before 1985				1985-1990				1990-1995			
	Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total
1. DESIGN TECHNOLOGIES												
Computer-Aided Design (CAD)	0	0	100	2	-	86	-	50	50	-	-	20
Computer-Aided Engineering (CAE)	50	29	0	36	-	43	100	27	-	14	-	8
CAD/CAM Integration	0	0	50	1	-	40	50	21	50	40	-	44
2. MANUFACTURING PLANNING AND CONTROL TECHNOLOGIES												
Computerized Financial Systems	67	86	50	76	33	29	50	31	-	-	-	-
Computerized Order Entry/Inventory Control	67	86	50	76	33	29	50	31	-	-	-	-
Computer-Aided Process Planning	33	43	50	38	33	71	50	52	33	-	-	16
Manufacturing Resource Planning Systems (MRP)	0	14	100	8	33	100	-	66	33	-	-	16
Automated Shop Floor Data Collection	0	17	0	8	33	83	100	57	33	17	-	25
Computerized Decision Support Systems	0	0	50	1	33	50	50	41	33	50	-	40
Computerized Maintenance Planning and Control	0	0	50	1	33	83	50	56	33	17	-	25
3. MANUFACTURING PROCESS TECHNOLOGIES												
Numerically Controlled Machines (NC)	50	50	100	51	-	67	-	37	-	17	-	9
Computer Controlled CN Machines (CNC)	0	60	100	32	50	40	-	44	-	40	-	20
CAD Directed CNC	0	0	50	1	-	75	50	35	50	25	-	38
Automatic Casting/Molding ("Near Net" Casting)	0	50	50	24	-	50	-	22	-	-	50	2
Computerized Process Control Systems	0	40	50	21	-	60	-	30	-	-	50	1
Computer-Aided Inspection and Testing	0	17	100	9	-	67	-	30	33	17	-	25
Robotic Applications	0	0	0	0	-	100	100	53	-	20	-	10
Flexible Manufacturing Technologies	0	0	0	0	-	50	100	25	-	25	-	11
Computer Integrated Manufacturing (CIM)	0	0	50	1	-	33	50	14	-	67	-	25
Other	0	0	0	0	-	50	50	16	-	50	-	15
4. MATERIALS HANDLING TECHNOLOGIES												
Automatic Bulk Handlers/Feeder Systems	33	67	0	42	-	33	50	11	-	33	50	11
Automated Conveyor/Vehicle Systems	0	0	0	0	-	25	100	14	-	25	-	11
Automated Storage and Retrieval	0	0	0	0	-	33	50	14	-	-	-	-
Computer Controlled Conveyor/Vehicles	0	0	0	0	-	-	100	3	-	33	-	13
Automated Warehouse	0	0	0	0	-	-	-	-	-	-	50	2
5. TELECOMMUNICATIONS TECHNOLOGIES												
Facsimile (FAX) Link: HO/Plant(s)	33	67	100	50	-	33	-	15	33	-	-	18
Computer Link: HO/Plant(s)	0	60	100	26	33	40	-	36	33	-	-	19
Computer Link: Suppliers/Customers	0	0	0	0	33	17	100	27	33	83	-	56

(1) '0' Used prior to 1985 to indicate have not adopted.
'-' used for periods 1985-1990 and 1990-1995 to indicate respondents, at time of survey, are not planning to adopt this technology or 'don't know'
Responses not mutually exclusive.

PART III - FUTURE TRENDS: THE SURVEY RESULTS

Part III of the study presents the survey results which discuss the firms' surveyed opinions as to future trends in technological adoption and employment impacts.

3.0 ADOPTION OF NEW TECHNOLOGY

This chapter reviews the expected trends in the adoption of new technologies in the Miscellaneous Machinery and Equipment Industry and the factors driving the needs and affecting the rate of technology adoption.

3.1 New Technologies and Rates of Adoption

The Machinery and Equipment industry is deeply affected by new design, manufacturing and process technologies for two reasons. First, these technologies have a strong impact on the operations firms perform in producing their own output, and, second, the Machinery and Equipment Industry products embody the new technologies to be used in other industries. This industry is, therefore, a conduit whereby many Canadian firms achieve access to new technologies.

Table 2 summarizes the percentage of firms who adopted new technologies before 1985 and their plans for using these technologies in the next five years and after 1990.

In General

- Firms with over 100 employees have been more aggressive than small firms in implementing new technologies to date. In the case of manufacturing control and planning systems, medium-sized firms have been more aggressive than large firms.

- Small firms have relatively few plans to adopt new technologies in the next ten years.

- Large firms expect to complete their adoption of most of the new technologies listed, by 1990.

3.1.1 Design Technologies

- Only the large firms have adopted computer-aided design and CAD/CAM integration by 1985. 86 percent of medium-sized firms expect to adopt CAD technologies by 1990 and 40 percent expect to adopt CAD/CAM integration by 1990. 50 percent of small firms expect to adopt CAD and CAD/CAM after 1990.

- 50 percent of small firms and 29 percent of medium-sized firms are already using computer aided engineering (CAE), and 43 percent of medium and all large firms expect to adopt CAE in the next five years.

3.1.2 Manufacturing Planning and Control Technologies

- 76 percent of firms have already adopted computerized financial systems and computerized order entry/inventory control. The remainder will introduce them in the next five years.

- 38 percent of firms have adopted computer-aided process planning and 52 percent will do so between 1985 and 1990. 33 percent of small firms will adopt this technology after 1990.

- Only 8 percent of firms now use manufacturing resource planning (MRP) (primarily large firms). Another 66 percent will adopt MRP in the next few years.

- There is limited use in 1985 of automated shop floor data collection, computerized decision support

systems and computerized maintenance planning and control, but they will be widely used (41 to 57 percent) by 1990 and most other firms will follow suit after 1990.

3.1.3 Manufacturing Process Technologies

- 51 percent (including all large firms) now use numerically controlled machines; 37 percent will adopt them in the next five years, and 9 percent after 1990.

- 32 percent (including all large firms) now use computer controlled machines (CNC); 44 percent will adopt them before 1990, and 20 percent after 1990.

- CAD directed CNC machines are used by only 1 percent of firms now, but will be adopted by 35 percent before 1990 and another 38 percent before 1995.

- 24 percent of firms now use automatic casting/moulding and computerized process control systems and half or more of medium sized firms will adopt them in the next five years.

- 25 percent of firms expect to introduce flexible manufacturing technologies before 1990; this includes 50 percent of medium sized firms and all large firms; but their use of flexible manufacturing and computer integrated manufacturing will be more limited (25 percent and 14 percent respectively) and more than half of medium sized firms will adopt these two technologies after 1990.

Experts interviewed made the comment that Canadian machinery makers had been slow to adopt NC machines when they first appeared in the 1960's, but they are moving quickly to take advantage of CNC machines.

Results of Question 4

TABLE 3: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Most Important Factors Driving Need to Adopt New Technologies

Factor		Percent of Firms by Employment Size: Small (20-99)	Medium (100-499)	Large (500+)	Total Firms
COMPETITIVE PRESSURES	First	0	14	0	8
	Second	100	14	50	49
	Third	0	14	0	8
	Weighted Importance (1)	2.0	0.9	1.0	1.3
STRATEGIC	First	0	14	50	9
	Second	0	14	0	8
	Third	0	0	0	0
	Weighted Importance	0.0	0.7	1.5	0.5
CUSTOMER DEMANDS FOR CHANGES	First	50	29	0	37
	Second	0	14	0	8
	Third	0	0	0	0
	Weighted Importance	1.5	1.1	0.0	1.3
INCREASE PROFITABILITY	First	0	0	50	1
	Second	0	0	0	0
	Third	0	14	0	8
	Weighted Importance	0.0	0.1	1.5	0.1
INCREASE PRODUCTIVITY	First	0	29	0	17
	Second	0	14	50	9
	Third	0	0	50	1
	Weighted Importance	0.0	1.1	1.5	0.7
INCREASE MANAGEMENT INFORMATION	First	0	0	0	0
	Second	0	0	0	0
	Third	0	29	0	17
	Weighted Importance	0.0	0.3	0.0	0.2
LOWER COSTS	First	50	14	0	28
	Second	0	43	0	25
	Third	0	0	0	0
	Weighted Importance	1.5	1.3	0.0	1.4
INCREASE SKILLS/ ORGANIZATIONAL CAPABILITY	First	0	0	0	0
	Second	0	0	0	0
	Third	50	14	0	28
	Weighted Importance	0.5	0.1	0.0	0.3
ENTER NEW MARKETS/ GROWTH	First	0	0	0	0
	Second	0	0	0	0
	Third	0	14	50	9
	Weighted Importance	0.0	0.1	0.5	0.1

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

3.1.4 Materials Handling Technologies

- 42 percent of firms now use automatic bulk handlers and another 11 percent will adopt them before 1990.

3.1.5 Telecommunications Technologies

- 50 percent of firms now have FAX links between head office and plants. 33 percent of medium sized firms will adopt them before 1990 and 33 percent of small firms after 1990.

- 60 percent of medium sized firms and all large firms now have computer links between head office and plants. The remaining 40 percent of medium sized firms will adopt them before 1990.

- No firms surveyed have computer links to suppliers/customers but 27 percent expect to introduce them before 1990 and 56 percent after 1990.

3.2 Forces Driving the Need to Adopt New Technology

Four main forces are drawing these firms to adopt new technologies. Table 3 summarizes the responses to a series of open-ended questions. The factors, which are ranked according to their weighted importance, are:

- Lower costs;
- Customer demands for changes;
- Competitive pressures; and
- Increase productivity.

However, the ranking for small firms was quite different from large firms. Small firms emphasized competitive pressures, lower costs and customer demand, whereas large firms were influenced by the drive to increase profitability, increase productivity, make

Results of Question 5

TABLE 4: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

SIC 315

Most Important Factors that Could Slow the Rate of New Technology Adoption

Factor		Percent of Firms by Employment Size			
		Small (20-99)	Medium (100-499)	Large (500+)	Total Firms
ABILITY TO FINANCE	First	50	0	0	20
	Second	0	14	0	8
	Third	50	0	50	21
	Weighted Importance (1)	2.0	0.3	0.5	1.0
COST OF NEW TECHNOLOGY	First	0	29	50	18
	Second	0	14	0	8
	Third	0	14	0	8
	Weighted Importance	0.0	1.3	1.5	0.8
COMPETITIVE ENVIRONMENT	First	50	0	0	20
	Second	0	29	0	17
	Third	0	-	0	0
	Weighted Importance	1.5	0.6	0.0	0.9
POOR ECONOMIC CONDITIONS	First	0	43	50	26
	Second	50	0	0	20
	Third	0	14	0	8
	Weighted Importance	1.0	1.4	1.5	1.3
LACK OF SKILLS AND/OR KNOW-HOW TO IMPLEMENT	First	0	14	0	8
	Second	0	29	50	18
	Third	0	0	0	0
	Weighted Importance	0.0	1.0	1.0	0.6
LACK OF NEW TECHNOLOGY STANDARDIZATION	First	0	14	0	8
	Second	50	0	0	20
	Third	0	29	0	17
	Weighted Importance	1.0	0.7	0.0	0.8
UNWILLINGNESS TO CHANGE	First	0	0	0	0
	Second	0	0	50	1
	Third	0	0	0	0
	Weighted Importance	0.0	0.0	1.0	0.0

(1) Weighted Importance = (First % x 3) + (second % x 2) + (First % x 1)

strategic moves in the market place and enter new markets. In short, the small firms appeared to be reacting defensively to these new technologies, while the large firms were actively using them as vehicles for growth.

3.3 Factors that Could Slow the Rate of Technology Adoption

The factors that tend to slow the rate at which machinery and equipment manufacturers adopt new technologies are summarized in Table 4. The most important factors for all reporting firms are:

- Poor economic conditions;
- Ability to finance;
- Competitive environment;
- Cost of new technology;
- Lack of new technology standardization; and
- Lack of skills and/or know-how to implement.

However, large and medium-sized firms mentioned poor economic conditions and cost of new technology as their two main concerns, while small firms mentioned ability to finance and competitive environment. There were no mentions of union or employee resistance, but large firms did mention a problem of unwillingness to change.

To summarize, firms with over 100 employees in the Miscellaneous Machinery and Equipment Industry have been more aggressive than small firms in adopting new technologies to date and small firms have relatively limited plans to adopt new technologies in the next ten years. Manufacturing planning and control, process and telecommunications technologies are now fairly prevalent among medium sized and large firms. These will become more widely adopted in the next five years, as will design and materials handling technologies. The main reasons why medium and large firms adopt these technologies are to enhance

performance and to pursue growth while small firms are forced to adopt them as a result of pressure from the marketplace. Small firms also feel inhibited by their inability to finance new technologies, while medium and large firms are more concerned about poor economic conditions and the cost of new technologies.

4.0 INDUSTRY OUTLOOK TO 1995

This chapter describes the respondents' view of the outlook for the industry in terms of aggregate output (i.e. manufacturing shipments in Ontario), investment plans, aggregate employment and changes in occupational structure to 1995.

4.1 Output to 1995

Following a 4 percent average annual growth rate from 1971 to 1981, the value of shipments (in constant dollars) declined by 20 percent from 1981 to 1982 to reach $1.1 billion. The firms surveyed estimated a decline of 14.5 percent in 1983, followed by gains of 19 percent in 1984, and 6.5 percent in 1985. They then projected annual growth of 4.5 percent from 1985 to 1995 (see Table 5). Medium sized firms were less optimistic than the other two groups. Both medium and large firms expect growth in the 1990's to be somewhat weaker than in the late 1980's, whereas small firms expect growth to strengthen in the 1990's. Experts in the field expect growth to be somewhat slower than the survey results would indicate. They do not expect shipments to reach the peak of $1.4 billion set in 1980 until the early 1990's, while the growth rates projected by the survey imply that the 1980 peak could be reached again by 1988.

4.2 Investment Patterns

Capital investment in the Ontario industry is estimated to be $516 million (in today's dollars) over the period 1990 to 1995, and to total $686 million over the period 1990 to 1995. This investment will be almost exclusively devoted to machinery and equipment and about 40 to 45 percent will be related to the implementation of new technologies.

Results of Question 1

TABLE 5: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS SIC 315

Manufacturing Shipments in Ontario

(1)

Average Annual Compound Rate of Change (in Constant Dollars)

Firms by Employment Size	Estimated			Expected	
	1982-1983	1983-1984	1984-1985	1985-1990	1990-1995
Small (20-99)	-35.0	40.0	13.5	5.5	6.5
Medium (100-499)	-1.0	5.0	-1.5	3.0	2.0
Large (500+)	-10.0	4.0	8.5	4.5	3.5
Total Firms	-14.5	19.0	6.5	4.5	4.5

(1) Rounded to closest 0.5 %

4.2.1 Justifying Financial Investments in New Technology

When considering investments in new technology, 92 percent of firms use the concept of pay back period in assessing such a decision (see Table 6). On average, these firms expect a pay back in less than four years. Only 9 percent of firms use return on investment (ROI) to evaluate investments but this includes the responses of all large firms. On average, these firms expect a 17 percent return.

4.2.2 Source of New Capital Spending

The Machinery and Equipment industry relies heavily on internal sources of funds to finance investment in new technologies, ranging from 75 percent for large firms to 91 percent for medium sized firms (see Table 7).

4.3 Employment to 1995

This section reviews expected trends in employment patterns and the most important factors affecting aggregate employment.

4.3.1 Factors Affecting Employment

When asked to identify the most important factors affecting the firm's employment level in Ontario, respondents identified the following ranked according to their weighted importance (see Table 8).

- Overall economic growth;
- Ability to compete;
- Industry-wide growth; and
- Success in foreign markets.

Success in foreign markets was particularly important for small and large firms.

Results of Question 17e

TABLE 6: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Justifying Financial Investment in New Technology

Firms by Employment Size	Pay-Back Period: % of Firms Using Pay-Back	Pay-Back Period: Average Period (Years)	Return on Investment: % of Firms Using ROI	Return on Investment: Average Rate (%)
Small (20-99)	100	4	0	-
Medium (100-499)	86	3	14	15.0
Large (500+)	50	1	100	27.5
Total Firms	92	3.6	9	17.2

Answers not mutually exclusive.

Results of Question 17f

TABLE 7: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Source of Funds for New Technology Spending

Employment Size	Internal Funds (Percent)	External Funds (Percent)
Small (20-99)	83	17
Medium (100-499)	91	9
Large (500+)	75	25
Total Firms	87	13

Results of Question 11a,b,c

TABLE 8: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Most Important Factors Affecting The Firms' Employment in Ontario

Factor		Percent of Firms by Employment Size			
		Small (20-99)	Medium (100-499)	Large (500+)	Total Firms
PROFITABILITY/ FINANCIAL STRENGTH	First	0	0	0	0
	Second	0	14	0	7
	Third	0	29	0	14
	Weighted Importance (1)	0.0	0.6	0.0	0.3
INCREASE SALES/ INCREASE MARKET SHARE	First	0	14	0	7
	Second	0	0	0	0
	Third	0	0	50	1
	Weighted Importance	0.0	0.4	0.5	0.2
INTRODUCTION OF NEW TECHNOLOGY	First	0	0	0	0
	Second	0	14	0	7
	Third	0	14	0	7
	Weighted Importance	0.0	0.4	0.0	0.2
SUCCESS IN FOREIGN MARKETS	First	33	0	50	17
	Second	0	14	0	7
	Third	0	0	0	0
	Weighted Importance	1.0	0.3	1.5	0.7
AVAILABILITY OF NECESSARY SKILLS	First	0	0	0	0
	Second	0	0	0	0
	Third	0	14	0	7
	Weighted Importance	0.0	0.1	0.0	0.1
ABILITY TO COMPETE	First	0	29	50	15
	Second	33	29	0	31
	Third	0	14	0	7
	Weighted Importance	0.7	1.6	1.5	1.1
INDUSTRY-WIDE GROWTH	First	33	14	0	24
	Second	0	0	0	0
	Third	0	14	0	7
	Weighted Importance	1.0	0.6	0.0	0.8
OVERALL ECONOMIC GROWTH	First	33	14	0	24
	Second	33	29	50	31
	Third	0	0	0	0
	Weighted Importance	1.7	1.0	1.0	1.3
FOREIGN EXCHANGE RATE/CANADIAN COMPETITIVENESS	First	0	14	0	7
	Second	0	0	0	0
	Third	33	0	0	17
	Weighted Importance	0.3	0.4	0.0	0.4
PRODUCT DIVERSIFICATION	First	0	14	0	7
	Second	0	0	0	0
	Third	0	14	0	7
	Weighted Importance	0.0	0.6	0.0	0.3
ALL OTHERS	First	0	0	0	0
	Second	0	0	50	1
	Third	0	0	0	0
	Weighted Importance	0.0	0.0	1.0	0.0

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

Results of Question 11d

TABLE 9: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS SIC 315

Firms' Employment Trends in Ontario

Firms by Employment Size	Total Employment and Average Annual Compound Rate of Change (1)			
	Estimated		Expected	
	Rate		Rate	
	1981-1984	1984-1985	1985-1990	1990-1995
Small (20-99)	1.0	13.0	5.5	4.5
Medium (100-499)	-2.5	-2.0	2.5	2.0
Large (500+)	1.0	-8.5	-0.5	-3.0
Total Firms	-1.0	0.0	2.5	2.0

(1) Rounded to closest 0.5%.

4.3.2 Employment Outlook

From 1971 to 1981, employment in Machinery and Equipment Manufacturing grew at an average annual rate of 2.2 percent. During 1982, employment dropped by 12 percent to 36,904. The survey findings shown in Table 9 suggest that employment increased in 1983 and 1984 but not quickly enough to recover the losses in 1982. Employment declined by 1 percent per year from 1981 to 1984. Respondents expect employment to be unchanged this year, for the industry as a whole. Small firms expect an increase of 13 percent, but this will be offset by medium firms, which expect a decline of 2 percent, and large firms, which expect a decline of 8.5 percent. Looking ahead, the reporting firms project an employment gain of 2.5 percent per year from 1985 to 1990 and gains of 2 percent per year from 1990 to 1995. Again, there is a wide disparity between small firms which expect strong employment increases (5.5 percent and 4.5 percent respectively in the two periods), medium firms (2.5 percent and 2 percent) and large firms which project employment declines (of 0.5 percent and 3 percent).

Experts in the industry do not expect employment to reach the 1981 level again even assuming reasonable market growth. They are therefore more in tune with the large firms' view of the future. They also point out that the employment levels of 1984 were influenced by extensive use of work sharing or short time working, so there is considerable excess capacity in the existing work force.

Results of Question 12

TABLE 10: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS SIC 315

Trends in Firms' Occupational Structure

Occupations	Percent of Total Employment by Selected Occupational Categories				
	Estimated			Expected	
	1981	1984	1985	1990	1995
MANAGERIAL, ADMINISTRATIVE AND RELATED	12.9	14.5	15.1	13.2	13.1
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	4.8	5.6	6.2	7.6	7.7
• Engineers		+	+	+	+
• Engineering Technicians and Technologists		o	o	o	o
• Systems Analysts and Computer Programmers		+	+	+	+
• All Other Science and Mathematics (not listed above)		o	o	o	o
PROCESSING	7.1	5.9	5.5	4.7	4.7
MACHINING	27.0	26.9	29.5	32.8	33.8
• Tool and Die Making		o	o	o	-
• Machinist and Machine Tool Setting-Up		o	o	+	+
• Machine-Tool Operators		+	+	+	+
• All Other Metal Shaping and Forming		o	o	o	-
• Welding and Flame Cutting		o	o	o	-
• Filing, Grinding, Buffing, Cleaning and Polishing		o	o	-	-
• All Other Machining (not listed above)		-	-	-	-
FABRICATING, ASSEMBLING AND REPAIRING	25.8	26.6	26.2	24.5	23.8
• Foremen		o	o	o	-
• Machinery: Fabricating and Assembly		o	-	+	+
• Electrical Equipment Installing and Repair		o	o	o	o
• Industrial Machinery Mechanics and Repairmen		o	o	o	+
• All Other Fabricating, Assembling and Repairing (not listed above)		-	+	o	+
MATERIALS HANDLING AND RELATED	4.1	4.0	3.4	3.2	3.0
ALL OTHER OCCUPATIONS	18.2	16.6	14.1	13.9	13.8
TOTAL	100%	100%	100%	100%	100%

+ increase - decrease o no change

4.3.3 Trends in Part-Time Work

Part-time employment is not a major factor in the Machinery and Equipment industry, accounting for only 1 percent of employment in 1981 and 1984. However, large firms plan to increase their use of part time workers in 1985 to about 7.5 percent of employment and to maintain that level over the next ten years. This will increase the average for all firms to about 2 percent over the period 1985 to 1995.

4.4 Changes in Occupational Structure

Table 10 shows trends in occupational structure (i.e., percent of total industry employment by occupation) in the Miscellaneous Machinery and Equipment Industry from 1981 to 1995. As explained earlier, respondents expect the number of jobs in the industry to increase, but the relative rates of growth of occupational groups will differ, with the results that the survey shows shifts in the proportion of the industry's work force as follows.

- A decline in the proportion of Managerial, Administrative and Related occupations from 1985 to 1990 and then a stabilization after 1990.

- A decline in Processing occupations from 1985 to 1990, followed by a slight increase.

- A significant decline in Fabricating, Assembling and Repairing from 1985 to 1990 followed by a slight further decline from 1990 to 1995.

- A decline in Materials Handling through the forecast period.

- A decline in All Other occupations.

Only two occupational groups are expected to increase in employment share:

- Natural Sciences, Engineering and Mathematics, and
- Machining occupations.

In conclusion, firms in Miscellaneous Machinery and Equipment industries expect a 4.5 percent rate of increase in the volume of manufacturing output in the next 10 years, slightly faster than the average growth of the 1970's. Investment will be concentrated almost entirely in machinery and equipment and approximately 45 percent of that investment will be related to new technology. Employment is expected to rise by 2.5 percent per year from 1985 to 1990 and by 2 percent from 1990 to 1995, but there are wide disparities in the projection of employment with large firms expecting declines and small firms expecting substantial increases. The fastest growth in employment is expected to occur in Natural Sciences and Engineering and in Machining. In all other occupational groups respondents anticipate declines in over all employment share.

5.0 EMPLOYMENT EFFECTS OF NEW TECHNOLOGY

This chapter reviews the survey results on the employment effects of new technology in terms of skills match and requirements and the impact on skill levels and job content.

5.1 Effects on Occupations

Table 11 summarizes firms' expectations of technology impact on occupational requirements. Many occupations will be in short supply within individual firms. The figures in brackets refer to the percent of firms expecting the shortage:

- Engineering technicians and technologists (63%);
- Systems analysts and computer programmers (57%);
- Engineers (43%) although 21 percent of firms expect an oversupply;
- Tool and die making (75%);
- Machinist and machine tool setting up (82%);
- Machine tool operators (74%);
- Industrial machinery mechanics and repairmen (80%);
- Electrical equipment installers and repairmen (47%); and
- Fabricating, assembling and repairing foremen (45%).

The occupations where an oversupply may occur are:

- Processing (26%), although 20 percent of the firms expect a shortage;
- Filing, grinding, buffing, cleaning and polishing (43%), but 20 percent expect a shortage;
- Welding and flame cutting (38%);
- Other metal shaping and forming (36%); and
- Materials Handling (18%).

Results of Question 6

TABLE 11: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Impact of Technology on Selected Occupations in Firms 1985-1995

Occupations	Percent of Firms		
	Oversupply	Shortage	No Response
MANAGERIAL, ADMINISTRATIVE AND RELATED	2	25	73
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	21	43	37
• Engineering Technicians and Technologists	9	63	28
• Systems Analysts and Computer Programmers	0	57	43
PROCESSING	26	20	54
MACHINING			
• Tool and Die Making	0	75	25
• Machinist and Machine Tool Setting-Up	1	82	17
• Machine-Tool Operators	8	74	18
• All Other Metal Shaping and Forming	36	0	64
• Welding and Flame Cutting	38	18	44
• Filing, Grinding, Buffing, Cleaning and Polishing	43	20	37
FABRICATING, ASSEMBLING AND REPAIRING			
• Foremen	10	45	45
• Machinery: Fabricating and Assembling	11	28	61
• Electrical Equipment Installing and Repair	0	47	53
• Industrial Machinery Mechanics and Repairmen	0	80	20
MATERIALS HANDLING AND RELATED	18	0	81
OTHER	0	18	82

5.2 Likely Steps to Deal with Skills Oversupply

In dealing with a potential oversupply of skills in their organizations, the most commonly cited steps are shown in Table 12 and summarized below:

Response	Most Common	Second Most Common	Third Most Common
Attrition	5	3	1
Retraining	6	2	0
Lateral Transfer	1	3	2
Layoffs	0	0	5
Upgrading	0	2	0
Downgrading	0	1	0

The clear preference is to overcome oversupply by attrition or by reallocating staff. Layoffs are viewed more as a last resort solution.

5.3 Likely Steps to Cope With Skills Shortages

In coping with anticipated skill shortages, the most commonly cited responses are shown in Table 13 and summarized below.

Response	Most Common	Second Most Common	Third Most Common
Recruiting	8	4	3
Upgrading	4	6	2
Retraining	3	4	3
Contracting Out	0	1	2

The dominant response will be to recruit new staff. Upgrading and retraining rank second and third, and contracting out falls well behind the other options. Contracting out is mentioned mainly in connection with engineering and computer programming skills.

Results of Question 7

TABLE 12: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS SIC 315

Steps Firms Will Likely Take to Deal With OVERSUPPLY of Skills 1985-1995

Occupations	Most Commonly Cited	Second Most Common	Third Most Common
MANAGERIAL, ADMINISTRATIVE AND RELATED	Attrition	Downgrade	Early Retirement
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	Attrition	Upgrade	Lateral Transfer
• Engineering Technicians and Technologists	Lateral Transfer	Upgrade	Attrition
PROCESSING	Attrition	Retrain	Layoffs
MACHINING			
• Machinist and Machine Tool Setting-Up	Attrition	Retrain	(1)
• Machine-Tool Operators	Retrain	Lateral Transfer	(1)
• All Other Metal Shaping and Forming	Retrain	Attrition	Layoffs
• Welding and Flame Cutting	Retrain	Lateral Transfer	Layoffs
• Filing, Grinding, Buffing, Cleaning and Polishing	Attrition	Layoffs	Lateral Transfer
FABRICATING, ASSEMBLING AND REPAIRING			
• Foremen	Retrain	Lateral Transfer	Upgrade
• Machinery: Fabricating and Assembly	Retrain	Attrition	Layoffs
MATERIALS HANDLING AND RELATED	Retrain	Attrition	Layoffs

(1) Only two steps mentioned.

Results of Question 8

TABLE 13: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS — SIC 315

Steps Firms Will Likely Take to Deal With SHORTAGE of Skills 1985-1995

Occupations	Most Commonly Cited	Second Most Common	Third Most Common
MANAGERIAL, ADMINISTRATIVE AND RELATED	Recruit	Upgrade	(1)
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	Recruit	Upgrade	Contract Out
• Engineering Technicians and Technologists	Recruit	Upgrade	Retrain
• Systems Analysts and Computer Programmers	Recruit	Upgrade	Contract Out
PROCESSING	Recruit	Retrain	(1)
MACHINING			
• Tool and Die Making	Upgrade	Recruit	Retrain
• Machinist and Machine Tool Setting-Up	Retrain	Upgrade	Recruit
• Machine-Tool Operators	Upgrade	Retrain	Recruit
• Welding and Flame Cutting	Recruit	Retrain	(1)
• Filing, Grinding, Buffing, Cleaning and Polishing	Upgrade	Recruit	(1)
FABRICATING, ASSEMBLING AND REPAIRING			
• Foremen	Retrain	Recruit	Upgrade
• Machinery: Fabricating and Assembly	Recruit	Upgrade	Retrain
• Electrical Equipment Installing and Repair	Upgrade	Contract Out	Recruit
• Indusry Machinery Mechanics and Repairmen	Retrain	Recruit	Upgrade
OTHER	Recruit	Retrain	(1)

(1) Only two steps mentioned.

Results of Question 9

TABLE 14: MISCELLANEOUS MACHINERY AND EQUIPMENT OPERATORS

SIC 315

Impact of Technology on Skill Levels and Job Content

(1) Percent of Firms

Occupations	Skills Required			Time to Achieve Proficiency			Knowledge of Firm's Operations		
	+	-	0	+	-	0	+	-	0
MANAGERIAL, ADMINISTRATIVE AND RELATED	80	0	20	55	0	45	80	0	20
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS									
• Engineers	51	20	29	35	28	37	79	0	21
• Engineering Technicians and Technologists	71	20	9	26	37	37	63	0	37
• Systems Analysts and Computer Programmers	65	0	35	44	10	46	76	0	24
PROCESSING	20	18	61	2	0	98	0	0	100
MACHINING									
• Tool and Die Making	35	10	55	1	10	89	1	10	89
• Machinist and Machine Tool Setting-Up	72	18	9	32	18	49	1	9	90
• Machine-Tool Operators	51	18	31	10	18	71	10	9	81
• All Other Metal Shaping and Forming	0	51	49	0	27	73	3	0	97
• Welding and Flame Cutting	33	18	49	0	18	82	18	0	82
• Filing, Grinding, Buffing, Cleaning and Polishing	0	42	58	0	28	72	15	0	85
FABRICATING, ASSEMBLING AND REPAIRING									
• Foremen	76	0	24	44	10	46	64	0	36
• Machinery: Fabricating and Assembly	48	5	47	24	5	71	2	0	98
• Electrical Equipment Installing and Repairing	81	0	19	79	0	21	60	0	40
• Industrial Machinery Mechanics and Repairmen	69	0	31	69	0	31	32	0	68
MATERIALS HANDLING AND RELATED	15	15	71	17	2	81	18	0	82
OTHER	10	0	90	10	0	90	90	0	10

+ increase - decrease 0 remain the same

(1) Non-responses excluded.

5.4 Technology Impact on Skill Levels and Job Content

Respondents were asked to rank the impact of new technologies on selected occupations for:

- skills required,
- time to achieve proficiency, and
- knowledge of firm's operations.

The results are summarized in Table 14. Respondents expected the skill levels required to rise in all occupations except Materials Handling, Processing, metal shaping and forming, and filing, grinding, buffing, cleaning and polishing. The largest number of respondents expected an increase in skill levels in Managerial (80%), engineering technicians and technologists (71%), machinists and machine tool setting-up (72%), fabricating foremen (76%) and electrical equipment installing and repairing (81%).

There was somewhat less concern about an increase in the time required to achieve proficiency, but firms did note this as follows: Managerial (55%), systems analysts and programmers (44%), and all the occupations in Fabricating, Assembling and Repairing (44 to 79%), with the exception of machinery fabricating and assembly.

An increase in the required knowledge of firm's operation was anticipated in Managerial (80%), engineers (79%), engineering technicians and technologists (63%), systems analysts and computer programmers (76%), foremen in fabricating operations (64%) and electrical equipment installation and repair (60%).

5.5 Training Costs and New Technology

Machinery makers estimate that they currently spend the equivalent of 2 percent of labour costs in training.

However, small firms appear to spend nothing on training. The amount spent on retraining by medium and large firms is expected to rise from 3 percent in 1985 to about 4 percent in the 1990 to 1995 period. Medium sized firms anticipate 30 percent of their training costs to new technology (up from 20 percent in 1984), while large firms anticipate 65 percent to new technology (up from 52 percent in 1984).

In general, firms which make miscellaneous machinery and equipment expect to experience more skill shortages than surpluses over the next ten years. The most widely anticipated shortages are in Machining occupations and in industrial machinery mechanics and repairmen. These firms expect to overcome these shortages through recruiting, upgrading and retraining existing employees. Cases of oversupply will be dealt with mainly through attrition, retraining and lateral transfers. The cost of retraining is expected to increase slightly from 2 percent to 2.3 percent of labour costs. Firms expect to see a marked increase in skill levels in many occupations. They also expect to see an increase in the required knowledge of the firm's operations in a number of occupations. There is not a high degree of concern about the time required to achieve proficiency except in the skills devoted to installing and repairing electrical and industrial machinery and, to a lesser extent, in Managerial occupations.

6.0 LABOUR RELATIONS ENVIRONMENT

This chapter discusses the labour relations environment in the industry.

6.1 Industrial Relations Environment: Historical

In the Machinery and Equipment Industry, 32 percent of the 36,904 employees are unionized. The major unions include the United Steelworkers which represents 37 percent of the unionized employees, the International Association of Machinists (Machinists) which represents a further 28 percent and the United Auto Workers (Auto Workers) which represents 15 percent of the total unionized workers. There are an additional 18 unions representing the industry including the following with 50 or more employees and ranked in decreasing order:

- Independent Locals
- United Electrical Workers
- Sheet Metal Workers
- Plumbers
- Structural Iron Workers
- Technical Engineers
- Woodworkers
- Office and Professional Employees
- Communications and Electronics

The major employers, as specified in Table 15, include the Outboard Marine Corp. of Canada based in Peterborough, Clark Equipment of Canada in St. Thomas, Dorr Oliver Canada Ltd. in Orillia, and Eaton Yale Ltd., Timberjack Division in Woodstock.

Technological arrangements have only been specified in 6 out of the 17 major union agreements. The most common clause specifies that training arrangements be made by the employer for employees who are affected by new technology adoption. Other clauses include transfer arrangements, consultation and advance notice of a technological change.

TABLE 15

INDUSTRIAL RELATIONS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

UNION	NUMBER OF MEMBERS	MAJOR EMPLOYER*	LOCATION	TECHNICAL CHANGE CLAUSE IN AGREEMENT
UNITED STEELWORKERS	700	Outboard Marine Corp. of Canada Ltd.	Peterborough	Other.
	376	Dorr Oliver Canada Ltd.	Orillia	None.
	340	Canadian Timken Ltd.	St. Thomas	None.
	300	Otis Elevator Company Limited	Hamilton	Training, Transfer Arrangements.
	250	Standard-Modern Technologies	York Borough	Training, Transfer Arrangements.
	225	Black Clawson-Kennedy Ltd.	Owen Sound	None.
MACHINISTS	475	Clark Equipment of Canada Ltd.	St. Thomas	None.
	318	Champion Road Machinery Ltd. & Gearco Ltd.	Goderich	None.
	261	Bata Engineering, Division of Bata Industries Limited	Batawa	Training.
	250	Cooper Energy Services	Stratford	None.
	210	Koehring Provincial Crane	Niagara Falls	None.
UNITED AUTO WORKERS	250	Caterpillar of Canada Ltd.	Brampton & Mississauga	None.
	248	MTD Products Limited	Kitchener	Training.
	215	WABCO Equipment of Canada Division of Wabco-Standard Inc.	Paris	None.
	200	American Hoist of Canada Ltd.	Brampton	None.
MOLDERS	354	Eaton Yale Ltd., Timberjack Division	Woodstock	Training, Advance Notice Consultation, Other.
BOILERMAKERS	250	Brown Boveri Howden	Scarborough	Consultation, Training.

* Employee with a union agreement affecting 200 or more employees. The unions listed above represent 44 percent of total employees in the machinery and equipment industries.

SOURCE: Collective Bargaining Agreements Systems, Ontario Ministry of Labour.

6.2 Trends in Unionization

The survey results reported in Table 16 indicate that firms with over 100 employees are more likely to be unionized than smaller firms. 60 percent of the firms are unionized, but only 33 percent of small firms. About 37 percent to 44 percent of employees were unionized in 1984 and 1985 and this proportion is expected to drop back to the 36 percent to 37 percent range over the next 10 years.

6.3 Technology Change Clauses

Of the firms surveyed, 27 percent reported contracts with technology change clauses with all the small firms reporting not having any such clause. All the contracts call for advance notice, 67 percent call for consultation and make provisions for job security and seniority rules (see Table 17).

6.4 Management's Perception of Their Union's Position on New Technology

Of the firm's reporting a union, 57 percent of the firms believe that the union accepts the need to adopt new technology. However, Chapter 3 indicates that firms do not consider union resistance to be a serious constraint on the adoption of new technologies. Firms did not offer much information about their perceptions of union concerns about the implementation of new technology.

6.5 Nature of Worker Involvement in the Process of Technological Change

Firms were asked whether they had a formal mechanism for worker participation in setting production and/or sales targets, improving productivity and/or quality, and adopting new technology. The following summarizes the survey results:

Results of Question 14a,b,c

TABLE 16: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

SIC 315

Union Representation in Firms

Firms by Employment Size	Percent of Firms With Union Representation	Of Firms with Union, Percent of Employment Unionized			
		Estimate		Expected	
		1984	1985	1990	1995
Small (20-99)	33	8	8	6	5
Medium (100-499)	86	56	57	55	53
Large (500+)	100	44	17	21	24
Total Firms	60	44	37	37	36

- Only 31 percent of the firms have mechanisms for worker participation at the working group level and none have provision for participation at the division, plant or company level,

- 37 percent have a mechanism for discussion with respect to improving productivity/quality, and

- 30 percent have mechanisms for participation in the adoption of new technology. This includes 57 percent of medium sized firms, all large firms, but no small firms.

The union leaders interviewed perceive even less consultation than the sample of firm's responses would suggest.

6.6 Views on Involving Workers in Decisions on Adopting New Technology

Management and union leaders were also asked to what extent and how should management involve workers in decisions regarding the adoption of new technologies.

Firms were divided in their views on the extent of involvement. Approximately 63 percent favoured prior consultation, 16 percent favoured full involvement, while 24 percent favoured no involvement at all.

Union leaders were unanimous in their view that advance notice would be desirable and one leader expressed a desire for full consultation and involvement at the design stage.

In conclusion, between 37 percent and 44 percent of the employees in the Machinery and Equipment Industry are unionized, and firms anticipate that the rate will average 37 percent to 38 percent over the next 10 years. The majority of firms believe that their

Results of Question 15d,e

TABLE 17: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURING

SIC 315

Unions and Technology Change

Firms by Employment Size	Percent of Contracts with a Technology Change Clause	Percent of Technology Change Clauses Covering					
		Notice/ Disclosure	Consultation/ Participation	Joint Committee	Job Security	Seniority	Other
Small (20-99)	0						
Medium (100-499)	17	100	100	0	100	0	0
Large (500+)	100	100	50	0	50	100	0
Total Firms	27	100	67	0	67	67	0

union accepts the need for new technology and the union leaders interviewed confirm this. Only 31 percent of the firms have a mechanism for worker involvement in adopting new technology, and only 37 percent provide for worker involvement on issues dealing with productivity or quality. (Consultation is less prevalent among small firms than medium sized and large ones). About 63 percent of the firms favour prior consultation, but only 14 percent favour full involvement in decisions regarding the adoption of new technologies.

Results of Question 18

TABLE 18: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

SIC 315

Planning for Technological Change

Firms by Employment Size	Strategic Plan	Human Resource Plan		Capital Investment Plan		Perceived Integration Between Capital and Human Plans (1)
	Percent of Firms With Plan	Percent of Firms With Plan	Length of Planning Horizon	Percent of Firms With Plan	Length of Planning Horizon	
Small (20-99)	67	33	6 years	33	5 years	2.0
Medium (100-499)	57	43	5 years	71	4 years	2.3
Large (500+)	100	100	4 years	100	5 years	4.0
Total Firms	63	39	5 years	53	5 years	2.3

1. Using a scale of 1 to 5; 1 represents "Not at all integrated" and 5 "Highly integrated".

7.0 PLANNING FOR TECHNOLOGICAL CHANGE

This chapter reports the survey results regarding questions related to planning for technological change. A summary of these results appears in Table 18.

The respondents indicate that 63 percent of the industry makes use of a strategic plan, with firms employing 500 or more generally more likely to have plans than the smaller and medium sized firms.

Human resource planning is less well established than capital investment planning for new technology with only 39 percent of the industry planning for future human resource needs compared to 53 percent for capital investment. The firms' average planning horizon is about 5 years which is slightly longer than their anticipated payback period for new machinery and equipment.

On average, these plans are only somewhat integrated, with the larger firms having more integration than either the medium or small firms.

PART IV - APPENDICES

Part IV of this report presents the appendices referred to in Parts I and II.

These appendices are:

Appendix	Title	Reference
A	Firm Employment Size Categories Used in the Survey of the Machinery and Equipment Industry	Part I
B	Questionnaire and Responses by Question	Part I Part III
C	Reliability of the Sample	Part I
D	Historical Tables	Part II

APPENDIX A

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF THE MACHINERY AND EQUIPMENT INDUSTRY

APPENDIX A

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF THE MISCELLANEOUS MACHINERY AND EQUIPMENT INDUSTRY

Size Categories Used to Stratify the Sample Frame		Size Categories Used to Weight and Report Survey Results	
Number of Employees			Number of Employees
20 - 49			
50 - 99		Small	20 - 99
100 - 199			
200 - 499		Medium	100 - 499
500 - 999			
1000 - 1499			
1500 - 2499		Large	500 or more
2500 - 4999			
5000 or more			

APPENDIX B

QUESTIONNAIRE

AND

RESPONSES BY QUESTION

ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

MISCELLANEOUS MACHINERY & EQUIPMENT MANUFACTURING (SIC 315) QUESTIONNAIRE

Currie, Coopers & Lybrand

INTRODUCTION

Thank you for agreeing to participate in the study. It is being carried out for the Ontario Task Force on Employment and New Technology, a joint labour-management group. Their mandate is to examine the extent and nature of employment change likely to result from the introduction and application of new technology in Ontario over the next ten years.

You Will Receive The Survey Results
As a participant, you will receive a report on the survey results for your industry.

All Responses Will Be Confidential
All responses will be held in strictest confidence. Responses will be analysed and used only at an industry-wide level.

Both Organized Labour and Management Are Being Surveyed
Management and organized labour participants, in the case of unionized firms, will both receive a questionnaire. We realize that labour participants may not be able to answer some of the questions. In particular, they may find difficulty in answering questions: 10, 11, 12, 13 and 17.

Participants May Want to Consult Key Resource People in Responding
The questionnaire is not necessarily meant to be completed by only one respondent. It may be appropriate and even desirable for survey participants to consult other key resource people in their firm before responding to the questionnaire. Respondents should indicate on the Participant Information (p.4), the "principle respondent" and "other respondents" as well as the Section(s) of the questionnaire to which they contributed.

You Will Save Time if Information is Filled in Before the Interview
A number of questions relate to your firm's past or present workforce and future plans. We are requesting management respondents to provide accurate information from their organization's records in advance of the interview. This step will reduce the time needed for the actual interview and also make it more meaningful. The Participant Information (p.4) and the following questions should be filled in prior to the management interview: 3, 6 to 13 inclusive, 15 and 17.

Group Interviews Are Possible
In some cases the principle respondent may want to arrange a group interview between himself, key resource people and our consultant. We would welcome such an arrangement. This option is open to either management or labour participants.

You May Wish to Complete the Entire Questionnaire Before the Interview
The entire questionnaire could be completed in advance of the interview. If this is convenient, please do so. We would, however, still wish to spend a half-hour with you to review your responses.

Your "Best" Estimate
Where estimates are required, we are asking respondents to provide us with their "best estimate". Estimating future trends is difficult. Our premise is that an expert inside the organization is in the best position to make them, based on his or her knowledge of the firm's future direction.

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EXHIBIT A

SELECTED OCCUPATIONS: MISCELLANEOUS MACHINERY & EQUIPMENT, SIC 315

MANAGERIAL, ADMINISTRATIVE & RELATED (includes senior and middle management and administrative support functions such as personnel officers, financial officers).

NATURAL SCIENCE, ENGINEERING & MATHEMATICS

Engineers.
Engineering Technicians & Technologists.
Systems Analysts & Computer Programmers.

PROCESSING (includes materials processing occupations such as in metal processing: refining, smelting, heat treating, rolling, moulding, casting, extruding, plating, testing and inspecting).

MACHINING

Tool & Die Making.
Machinist & Machine-Tool Set-Up.
Machine-Tool Operators.
All Other Metal Shaping & Forming.
Welding & Flame Cutting.
Filing, Grinding, Buffing, Cleaning & Polishing.

FABRICATING, ASSEMBLING & REPAIRING

Foremen: Fabricating & Assembly
Machinery: Fabricating & Assembly.
Electrical Equipment Installing & Repairing
Industrial Machinery Mechanics & Repairmen.

MATERIAL HANDLING & RELATED (includes such occupations as hoisting, material handling equipment operators and packaging).

The Study is Focusing on Selected Occupations

The Task Force for your industry is focusing on chosen major occupational groups and selected occupations within these major groups. These are listed in Exhibit A. The job titles and definitions being used are from the "Canadian Classification and Dictionary of Occupations, 1971" (CCDO). The CCDO is a universal system of job titles and descriptions. Our consultants are available to assist you or your staff in clarifying which of your firm's positions should be considered in the CCDO titles listed in Exhibit A.

Please Call If You Have Any Enquiries

Should you or your staff require any assistance, please call Sandra Skivsky of our firm or the consultant who will be interviewing you, at 366-1921.

Your Participation Is Appreciated

While we appreciate that your participation in the survey puts a demand on your time and organization, we would emphasize that your contribution will have an important impact on the results of this project.

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PARTICIPANT INFORMATION

COMPANY NAME: _____
UNION NAME (If appropriate): _____
AFFILIATED ORGANIZATIONS: _____
MAIN ADDRESS: _____
TELEPHONE NUMBER: ( ) _____

BRIEF DESCRIPTION OF OPERATION IN ONTARIO

Divisions/Branches/Affiliates	Products/Services
_____	_____
_____	_____
_____	_____
_____	_____

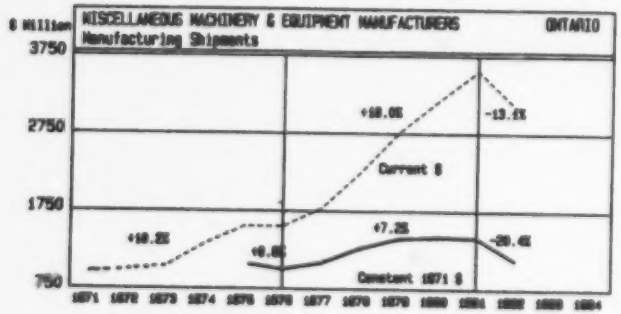
SURVEY PARTICIPANTS

Names	Position	Number of Years With Company	Number of Years With Industry	Check (✓) Sections Answered II	III	IV	V	VI	VII
_____ (principal respondent)	_____	_____	_____	☐	☐	☐	☐	☐	☐
_____ (other respondents)	_____	_____	_____	☐	☐	☐	☐	☐	☐
_____	_____	_____	_____	☐	☐	☐	☐	☐	☐
_____	_____	_____	_____	☐	☐	☐	☐	☐	☐
_____	_____	_____	_____	☐	☐	☐	☐	☐	☐

(SIC 315)

CHART 1

INDUSTRY-WIDE MANUFACTURING SHIPMENTS IN ONTARIO*



* Source: Statistics Canada, Manufacturing Industries of Canada: National and Provincial Areas, Cat. No. 31-203. Graph, constant dollar calculation and rates of change by Economics Practice, Currie, Coopers & Lybrand.

(SIC 315)

1. INDUSTRY-WIDE MANUFACTURING SHIPMENTS IN ONTARIO

Chart 1, opposite, illustrates manufacturing shipments for the Miscellaneous Machinery & Equipment Industry in ONTARIO in current dollars (dotted line) and in constant dollars (current dollars adjusted for price changes, dotted line).

The rates shown for the first three time periods listed below are expressed in annual compound rates of change (in constant dollars).

Using these rates as a guide, please estimate the annual compound rates of change (in constant dollars) of your industry's manufacturing shipments in Ontario for the next five periods listed.

Manufacturing Shipments in Ontario	Annual Compound Rate of Change (in constant dollars)
1971 to 1976	+0.8 %
1976 to 1981	+7.2 %
1981 to 1982	-20.4 %
	Your Estimates (Indicate if + or -)
1982 to 1983?	___ %
1983 to 1984?	___ %
1984 to 1985?	___ %
1985 to 1990?	___ %
1991 to 1995?	___ %

(SIC 315)

2. INDUSTRY-WIDE OUTLOOK - EMPLOYMENT IN ONTARIO

The table below indicates total employment and annual compound rates of change for employment in the Miscellaneous Machinery and Equipment Manufacturing Industry in ONTARIO between 1971 and 1983. (Statistics Canada, Cat. No. 31-203):

Would you please indicate your estimates for the five following periods listed below (i.e., 1983-1995). Provide your estimates in actual numbers or in annual compound rates of change, whichever is easier.

For your information, total employment covers full-time, part-time, temporary, casual and contract - i.e., total "head count".

Total Employment in Ontario			Annual Compound Rates of Change	
1971	33,738			
1981	41,953		1971-1981	+2.2 %
1982	36,904		1981-1982	-12.0 %

Your Estimates:

				(Indicate if + or -)
1983?	_____	OR	1982-1983	___ %
1984?	_____	OR	1983-1984?	___ %
1985?	_____	OR	1984-1985?	___ %
1990?	_____	OR	1985-1990?	___ %
1995?	_____	OR	1990-1995?	___ %

(SIC 315)

3. FIRM'S ADOPTION OF TECHNOLOGIES

The following questions refer to new technologies your firm has already or may adopt over the next ten years in ONTARIO.

3a. Please indicate the technologies that have already been adopted by your firm. Record your answer on Chart 3, opposite, under column 3a.

3b. Please indicate the technologies that will probably be adopted by your firm between 1985 and 1990. Record your answer on Chart 3, under column 3b. It may be appropriate to check more than one time period.

3c. Please indicate the technologies that will probably be adopted by your firm between 1991 and 1995. Record your answer on Chart 3, under column 3c. It may be appropriate to check more than one time period.

(SIC 315)

CHART 3

TECHNOLOGIES ADOPTED OR TO BE ADOPTED BY THE FIRM

	3a ADOPTED IN 1984 OR BEFORE	3b WILL BE ADOPTED BETWEEN 1985-1990?	3c WILL BE ADOPTED BETWEEN 1991-1995?
1. DESIGN TECHNOLOGIES			
Computer-Aided Design (CAD)	☐	☐	☐
Computer-Aided Engineering (CAE)	☐	☐	☐
CAD/CAM Integration	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
2. MANUFACTURING PLANNING & CONTROL SYSTEMS			
Computerized Financial Systems	☐	☐	☐
Computerized Order Entry/Inventory Control	☐	☐	☐
Computer-Aided Process Planning	☐	☐	☐
Manufacturing Resource Planning Systems (MRP)	☐	☐	☐
Automated Shop Floor Data Collection	☐	☐	☐
Computerized Decision Support Systems	☐	☐	☐
Computerized Maintenance Planning & Control	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
3. MANUFACTURING PROCESS TECHNOLOGIES			
Numerically Controlled Machines (NC)	☐	☐	☐
Computer Controlled CN Machines (CNC)	☐	☐	☐
CAD Directed CNC	☐	☐	☐
Automatic Casting/Molding ("Near Net" Casting)	☐	☐	☐
Computerized Process Control Systems	☐	☐	☐
Computer-Aided Inspection & Testing	☐	☐	☐
Robotic Applications	☐	☐	☐
Flexible Manufacturing Technologies	☐	☐	☐
Computer Integrated Manufacturing (CIM)	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
4. MATERIALS HANDLING TECHNOLOGIES			
Automatic Bulk Handlers/Feeder Systems	☐	☐	☐
Automated Conveyor/Vehicle Systems	☐	☐	☐
Automated Storage & Retrieval	☐	☐	☐
Computer Controlled Conveyor/Vehicles	☐	☐	☐
Automated Warehouses	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
5. TELECOMMUNICATIONS TECHNOLOGIES			
Facsimile (FAX) Link: HO/Plants	☐	☐	☐
Computer Link: HO/Plant(s)	☐	☐	☐
Computer Link: Suppliers/Customers	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
6. OTHER TECHNOLOGIES			
_____	☐	☐	☐
_____			
HAVE/WILL NOT ADOPT ANY NEW TECHNOLOGIES	☐	☐	☐

4. FORCES DRIVING THE FIRM'S NEED FOR NEW TECHNOLOGIES OVER THE NEXT 10 YEARS

4a. What is the **single most important driving factor** in your firm's internal or external environment which could accelerate your firm's **need to adopt** these new technologies over the next 10 years in ONTARIO?

4b. What is the **second most important factor** likely to accelerate your firm's need to adopt these new technologies?

4c. And what is the **third most important factor**?

5. FACTORS AFFECTING THE FIRM'S RATE OF TECHNOLOGY ADOPTION OVER THE NEXT 10 YEARS

5a. What is the **single most important factor** in your firm's internal or external environment that could slow down the speed at which your firm will adopt these new technologies over the next 10 years in ONTARIO?

5b. What is the **second most important** factor that could slow down your firm's adoption of these new technologies?

5c. And what is the **third most important** factor?

6. IMPACT OF TECHNOLOGY ON OCCUPATIONS OVER THE NEXT 10 YEARS

The following questions attempt to determine impacts on specific occupations you expect to be caused by the adoption of new technologies in your firm over the next 10 years in ONTARIO.

6a. Please indicate the **occupations** in which your firm is likely to have an **oversupply of people** over the next 10 years as a result of the adoption of these new technologies. Record your answer on Chart 6, opposite, under column 6A.

6b. Please indicate the **occupations** in which you expect your firm will have a **shortage of the skills** required to cope with these new technologies. Record your answer on Chart 6, under column 6B.

(SIC 315)

CHART 6

IMPACT OF TECHNOLOGIES ON SELECTED OCCUPATIONS IN YOUR FIRM OVER THE NEXT 10 YEARS

	6a OCCUPATIONS WITH AN OVERSUPPLY OF SKILLS	6b OCCUPATIONS WITH A SHORTAGE OF THE REQUIRED SKILLS
MANAGERIAL, ADMINISTRATIVE & RELATED	☐	☐
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers	☐	☐
• Engineering Technicians & Technologists	☐	☐
• Systems Analysts & Computer Programmers	☐	☐
PROCESSING	☐	☐
MACHINING		
• Tool & Die Making	☐	☐
• Machinist & Machine-Tool Set-Up	☐	☐
• Machine-Tool Operators	☐	☐
• All Other Metal Shaping & Forming	☐	☐
• Welding & Flame Cutting	☐	☐
• Filing, Grinding, Buffing, Cleaning & Polishing	☐	☐
FABRICATING, ASSEMBLING & REPAIRING		
• Foremen	☐	☐
• Machinery: Fabricating & Assembly	☐	☐
• Electrical Equipment Installing & Repair	☐	☐
• Industrial Machinery Mechanics & Repairmen	☐	☐
MATERIAL HANDLING AND RELATED	☐	☐
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		
_____	☐	☐
_____	☐	☐
_____	☐	☐

(SIC 315)

7. ACTIONS TO DEAL WITH OVERSUPPLY OF SKILLS IN FIRM OVER NEXT 10 YEARS

The following questions relate to the actions your firm will likely take to deal with the oversupply of people in your firm resulting from the adoption of these new technologies in ONTARIO.

7a. For each occupation with a potential oversupply of skills (as you indicated in Q.6a), please identify the steps your firm will likely take that will affect the largest number of people in that occupation. Record your answers on Chart 7, opposite, under column 7a.

In answering this and the following question, please consider the possible actions listed below as well as any other possible action not in the list but that your firm is likely to take.

Possible Actions

- Attrition
- Early Retirement
- Layoffs
- Relocation (geographic)
- Shorter hours/work week
- Job sharing
- Change from full-time to part-time
- Retraining
- Lateral transfer
- Upgrading
- Downgrading
- Etc. etc.,

7b. Again, for each of these occupations, identify the step your firm may take that will affect the second largest number of people in that occupation. Record on Chart 7, under column 7b.

(SIC 315)

CHART 7

STEPS FIRM WILL LIKELY TAKE
TO DEAL WITH OVERSUPPLY OF SKILLS OVER NEXT 10 YEARS

OCCUPATIONS	7a STEPS THAT WILL AFFECT THE LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION	7b STEPS THAT WILL AFFECT THE 2ND LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION
MANAGERIAL, ADMINISTRATIVE & RELATED		
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers		
• Engineering Technicians & Technologists		
• Systems Analysts & Computer Programmers		
PROCESSING		
MACHINING		
• Tool & Die Making		
• Machinist & Machine-Tool Set-Up		
• Machine-Tool Operators		
• All Other Metal Shaping & Forming		
• Welding & Flame Cutting		
• Filing, Grinding, Buffing, Cleaning & Polishing		
FABRICATING, ASSEMBLING & REPAIRING		
• Foremen		
• Machinery: Fabricating & Assembly		
• Electrical Equipment Installing & Repair		
• Industrial Machinery Mechanics & Repairmen		
MATERIAL HANDLING AND RELATED		
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		
_____		
_____		
_____		

(SIC 315)

8. STEPS TO ACQUIRE THE NEW SKILL REQUIREMENTS OVER THE NEXT 10 YEARS

The following questions are intended to identify the most likely steps your firm may take to acquire the new skill requirements associated with the new technologies over the next 10 years in ONTARIO.

8a. Please indicate, for each occupation with a potential shortage of the new skill requirements (as you indicated in Q6b), the step your firm will likely take that will affect the largest number of people in that occupation. Record your answers on Chart 8, column 8a.

Please consider the possible actions listed below as well as any other action (not listed) that your firm is likely to take.

Likely Steps

- Retraining
- Relocation
- Upgrading
- Increased overtime of firm's skilled people
- Recruiting full-time skilled people
- Recruiting part-time skilled people
- Contracting work out
- Etc., etc...

8b. Please indicate, for each occupation, the step your firm may take that will affect the second largest number of people in that occupation. Record your answers in column 8b.

CHART 8

STEPS FIRM WILL TAKE
OVER NEXT 10 YEARS TO ACQUIRE THE NEW SKILL REQUIREMENTS

OCCUPATIONS	8a STEP WHICH WILL AFFECT THE LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION	8b STEP WHICH WILL AFFECT THE 2ND LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION
MANAGERIAL, ADMINISTRATIVE & RELATED		
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers		
• Engineering Technicians & Technologists		
• Systems Analysts & Computer Programmers		
PROCESSING		
MACHINING		
• Tool & Die Making		
• Machinist & Machine-Tool Set-Up		
• Machine-Tool Operators		
• All Other Metal Shaping & Forming		
• Welding & Flame Cutting		
• Filing, Grinding, Buffing, Cleaning & Polishing		
FABRICATING, ASSEMBLING & REPAIRING		
• Foremen		
• Machinery: Fabricating & Assembly		
• Electrical Equipment Installing & Repair		
• Industrial Machinery Mechanics & Repairmen		
MATERIAL HANDLING AND RELATED		
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		

9. NATURE OF IMPACT ON SKILLS AND JOB CONTENT OVER THE NEXT TEN YEARS

The following questions are meant to identify the nature of the impact on selected occupations in ONTARIO.

9a. For selected occupations in your firm, please indicate how the new technologies will affect each in their daily work. That is, will their daily work require greater skill (+), less skill (-), or about the same skill (0) as they currently require. Record your answers on Chart 9, opposite, under Column 9a.

9b. Please indicate whether the new skills they require will demand more time (+), less time (-), or about the same time (0) to achieve the proficiency that they will need. Record your answers on Chart 9, column 9b.

9c. Please indicate whether, in using these new technologies, these occupations will require more knowledge (+) of the company's operations, less knowledge (-), or about the same (0) amount of knowledge as is currently required to perform their daily tasks. Record your answers on Chart 9, under 9c.

(SIC 315)

CHART 9

IMPACT OF TECHNOLOGY ON SKILL LEVELS AND JOB CONTENT

	9a SKILLS REQUIRED (+, -, 0)	9b TIME TO ACHIEVE PROFICIENCY (+, -, 0)	9c KNOWLEDGE OF COMPANY'S OPERATIONS (+, -, 0)	COMMENTS
MANAGERIAL, ADMINISTRATIVE, & RELATED	___	___	___	_____
NATURAL SCIENCE, ENGINEERING & MATHEMATICS				
• Engineers	___	___	___	_____
• Engineering Technicians & Technologists	___	___	___	_____
• Systems Analysts & Computer Programmers	___	___	___	_____
PROCESSING	___	___	___	_____
MACHINING				
• Tool & Die Making	___	___	___	_____
• Machinist & Machine-Tool Set-Up	___	___	___	_____
• Machine-Tool Operators	___	___	___	_____
• All Other Metal Shaping & Forming	___	___	___	_____
• Welding & Flame Cutting	___	___	___	_____
• Filing, Grinding, Buffing, Cleaning & Polishing	___	___	___	_____
FABRICATING, ASSEMBLING & REPAIRING				
• Foremen	___	___	___	_____
• Machinery: Fabricating & Assembly	___	___	___	_____
• Electrical Equipment Installing & Repair	___	___	___	_____
• Industrial Machinery Mechanics & Repairmen	___	___	___	_____
MATERIAL HANDLING AND RELATED	___	___	___	_____
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?				
_____	___	___	___	_____
_____	___	___	___	_____
_____	___	___	___	_____

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10. TRAINING/RETRAINING

These questions are about the current and future importance of **training and retraining** in your organization.

10a. Please indicate what were your firm's total training costs as a percent of total labour costs in 1981. Record your answer on Chart 10, line 10a.

Training costs include the costs of internally or externally provided training programs, classroom and on-the-job workshops, vouchers or tuition credits, provided by your firm, which are intended to train employees to perform their jobs or to retrain employees to assume new or alternate jobs. Labour costs include all wages, salaries and benefits. (e.g., $\frac{\text{Total Training Costs}}{\text{Total Labour Costs}} \times 100 = 1.0\%$)

10b. Please indicate what your firm's total training costs as a percent of total labour costs will be in 1984 (to year end). Record your answer on line 10b.

10c. What do you estimate for 1985, (line 10c)?

10d. What do you estimate it will be in 1990, (line 10d)?

10e. What do you estimate it will be in 1995, (line 10e)?

10f. For each year on Chart 10, (line 10a to 10e), please indicate what percent of total training costs in each year have or will go towards training people to adapt to the new technologies.

CHART 10

TRAINING COSTS OF FIRM

			As a Percent of Total Labour Costs	Percent of Total Training Costs Directly Related to New Technologies
10a.	1981?	Actual	___%	___%
10b.	1984?	Estimate	___%	___%
10c.	1985?	Estimate	___%	___%
10d.	1990?	Estimate	___%	___%
10e.	1995?	Estimate	___%	___%

(SIC 315)

(SIC 315)

11. FIRM'S EMPLOYMENT TRENDS

In this section, we would like to determine how the firm's employment levels in ONTARIO are likely to change over the next 10 years.

11a. To begin, considering all possible factors in your firm's internal and external environment, what is the **single most important factor** which will have an impact on your firm's level of employment in ONTARIO over the next 10 years? _____

_____

11b. The **second most important factor**? _____

_____

11c. The **third most important factor**? _____

_____

11d. Please indicate **total employees** (includes full-time, temporary, contract, casual, seasonal and part-time employment) in your organization in ONTARIO for **1971, 1981 and 1984** from your employment records. Record your answers on Chart 11, column 11d.

Please estimate future total employment in your organization in ONTARIO for **1985, 1990 and 1995.**

11e. Please indicate the **percent** of your total employment in ONTARIO that are **part-time employees** (i.e., less than normal full work week), for **1981 and 1984.** Record your answers on Chart 11, column 11e.

Also in column 11e, please estimate part-time employees as a percent of total employees in ONTARIO for **1985, 1990 and 1995.**

11f. Please translate your total ONTARIO employment (include full-time, part-time, casual, temporary, seasonal) into a full-time equivalent (F.T.E.) figure for your firm for **1981 and 1984** in column 11f.

Also in column 11f, please estimate total employment in terms of a full-time equivalent (F.T.E.) for **1985, 1990 and 1995.**

By F.T.E. we mean a normal, full, work week for a normal, full year. F.T.E. can be measured in a variety of ways depending on whatever is normal for your firm or industry. For example, if expressed in hours of work per year one FTE might range from 1750 to 2000 hours of work a year depending on the length of the normal work week (e.g., 35 hours/week x 50 weeks = 1750 hours, 40 hours/week x 50 weeks = 2000 hours.)

CHART 11

FIRM'S EMPLOYMENT TRENDS IN ONTARIO

	11d TOTAL EMPLOYMENT IN ONTARIO	11e PART-TIME EMPLOYEES AS A % OF TOTAL EMPLOYMENT	11f TOTAL EMPLOYMENT IN FULL-TIME EQUIVALENT (F.T.E.)
Actual Figures			
1971?	_____		
1981?	_____	_____ %	_____ FTE
1984?	_____	_____ %	_____ FTE
Your Estimates			
1985?	_____	_____ %	_____ FTE
1990?	_____	_____ %	_____ FTE
1995?	_____	_____ %	_____ FTE

12. CHANGES IN EMPLOYMENT STRUCTURE

This section is intended to measure the changes in the employment structure of your firm in ONTARIO between 1981 and 1995.

12a. Please indicate the actual percentage share of <u>each</u> occupation listed as a percent of your firm's total employment in ONTARIO in 1981. Record your answer on Chart 12, column 12a.

12b. Please indicate the actual percentage share of <u>each</u> selected occupation listed as a percent of your firm's total employment in ONTARIO in 1984. Record your answer in column 12b.

12c. Please estimate the same for each selected occupation in 1985. Record in column 12c.

12d. Please estimate the same for each selected occupation in 1990. Record in column 12d.

12e. Please estimate the same for each selected occupation in 1995. Record in column 12e.

(SIC 315)

CHART 12

TRENDS IN FIRM'S OCCUPATIONAL STRUCTURE BETWEEN 1981 AND 1995

	OCCUPATIONS AS A PERCENT OF TOTAL EMPLOYMENT OF THE FIRM IN ONTARIO					
	12a Actual 1981	12b Actual 1984	12c Estimate 1985	12d Estimate 1990	12e Estimate 1995	
	%	%	%	%	%	
MANAGERIAL, ADMINISTRATIVE, & RELATED	☐	☐	☐	☐	☐	1a
NATURAL SCIENCE, ENGINEERING & MATHEMATICS	☐	☐	☐	☐	☐	2a
• Engineers	___	___	___	___	___	
• Engineering Technicians & Technologists	___	___	___	___	___	
• Systems Analysts & Computer Programmers	___	___	___	___	___	
• All Other Science & Mathematics (not listed above)	___	___	___	___	___	
PROCESSING	☐	☐	☐	☐	☐	3a
MACHINING	☐	☐	☐	☐	☐	4a
• Tool & Die Making	___	___	___	___	___	
• Machinist & Machine-Tool Set-Up	___	___	___	___	___	
• Machine-Tool Operators	___	___	___	___	___	
• All Other Metal Shaping & Forming	___	___	___	___	___	
• Welding & Flame Cutting	___	___	___	___	___	
• Filing, Grinding, Buffing, Cleaning & Polishing	___	___	___	___	___	
• All Other Machinery (not listed above)	___	___	___	___	___	
FABRICATING, ASSEMBLING & REPAIRING	☐	☐	☐	☐	☐	5a
• Foremen	___	___	___	___	___	
• Machinery: Fabricating & Assembly	___	___	___	___	___	
• Electrical Equipment Installing & Repair	___	___	___	___	___	
• Industrial Machinery Mechanics & Repairmen	___	___	___	___	___	
• All Other Fabricating, Assembling, & Repairing (not listed above)	___	___	___	___	___	
MATERIAL HANDLING AND RELATED	☐	☐	☐	☐	☐	6a
ALL OTHER OCCUPATIONS	☐	☐	☐	☐	☐	7a
• FIRM'S TOTAL EMPLOYMENT IN ONTARIO (1+2+3+4+5+6+7 = 100%)	100%	100%	100%	100%	100%	

SIC 315)

13. EMPLOYMENT STRUCTURE BY SEX

The following questions refer to your firm's employment in ONTARIO by sex for each specific occupation listed in Chart 13.

13a. Please provide the percentage split between male and female of your employees in ONTARIO by each occupation in 1981. Record your answer on Chart 13, column 13a.

13b. Please provide the percentage split between male and female employees by occupation in ONTARIO in 1984. Record your answer in Column 13b.

(SIC 315)

CHART 13

EMPLOYMENT STRUCTURE BY SEX AND OCCUPATION IN ONTARIO

	13a 1981 EMPLOYMENT MALE	FEMALE	TOTAL	13b 1984 EMPLOYMENT MALE	FEMALE	TOTAL
MANAGERIAL, ADMINISTRATIVE & RELATED	___% +	___%	=100%	___% +	___%	=100%
NATURAL SCIENCE, ENGINEERING & MATHEMATICS						
• Engineers	___% +	___%	=100%	___% +	___%	=100%
• Engineering Technicians & Technologists	___% +	___%	=100%	___% +	___%	=100%
• Systems Analysts & Computer Programmers	___% +	___%	=100%	___% +	___%	=100%
PROCESSING	___% +	___%	=100%	___% +	___%	=100%
MACHINING						
• Tool & Die Making	___% +	___%	=100%	___% +	___%	=100%
• Machinist & Machine-Tool Set-Up	___% +	___%	=100%	___% +	___%	=100%
• Machine-Tool Operators	___% +	___%	=100%	___% +	___%	=100%
• All Other Metal Shaping & Forming	___% +	___%	=100%	___% +	___%	=100%
• Welding & Flame Cutting	___% +	___%	=100%	___% +	___%	=100%
• Filing, Grinding, Buffing, Cleaning & Polishing	___% +	___%	=100%	___% +	___%	=100%
FABRICATING ASSEMBLING & REPAIRING						
• Foremen	___% +	___%	=100%	___% +	___%	=100%
• Machinery: Fabricating & Assembly	___% +	___%	=100%	___% +	___%	=100%
• Electrical Equipment Installing & Repair	___% +	___%	=100%	___% +	___%	=100%
• Industrial Machinery Mechanics & Repairmen	___% +	___%	=100%	___% +	___%	=100%
MATERIAL HANDLING AND RELATED	___% +	___%	=100%	___% +	___%	=100%
FIRM'S TOTAL EMPLOYEES IN ONTARIO	___% +	___%	=100%	___% +	___%	=100%

(SIC 315)

14. ORGANIZED LABOUR IN YOUR FIRM IN ONTARIO

14a. Does your firm have any workers in ONTARIO covered by a collective labour agreement(s)?

Yes ☐ No ☐ If so, go on to Question 14c.

14b. If yes, what percent of your firm's total employment in ONTARIO is currently (1984) unionized?

____%

14c. What percent of your firm's total employment in ONTARIO do you estimate will be unionized by 1985, 1990 and by 1995?

- 1985? ____%
- 1990? ____%
- 1995? ____%

14d. If you expect an increase in the percent of total employment that will be unionized, please indicate the specific occupational groups within which you expect the increase will take place.

_____

_____

15. ORGANIZED LABOUR AND TECHNOLOGY CHANGE

If any of the employees in your firm in ONTARIO are represented by a union, please answer the following series of questions. If none of the workers in your firm in ONTARIO are unionized, please go on to Question 16, p. 22.

15a. Please indicate the name of the union(s) in your firm in ONTARIO. Record your answers on Chart 15, on line 15a.

15b. On line 15b, please indicate the number of the firm's employees in ONTARIO in each union.

15c. On line 15c, indicate the worker groups in your firm the union(s) represents.

15d. On line 15d, check ☑ if the contract(s) has a technology change clause(s).

15e. On line 15e, check ☑ if the technology change clause(s) covers any of the following:

- Notice/Disclosure
- Consultation/Participation
- Joint Technology Change Committee
- Job Security
- Seniority
- Other (please specify).

15f. On line 15f, indicate whether the clause(s) is effectively administered. If your answer is "NO", please explain your answer.

CHART 15

ORGANIZED LABOUR IN ONTARIO

	(name of union)	(name of union)	(name of union)
15a. Name of Unions in Firm			
15b. Number of Firm's Employees in Each Union			
15c. Worker Groups Represented by Each Union			
15d. Does Union(s) Contract(s) Have a Technology Change Clause(s)?			
YES	☐	☐	☐
NO	☐	☐	☐
15e. Check ☑ if Technology Change Clause(s) Includes:			
• Notice/Disclosure	☐	☐	☐
• Consultation/Participation	☐	☐	☐
• Joint Technology Change Committee	☐	☐	☐
• Job Security	☐	☐	☐
• Seniority	☐	☐	☐
• Other _____ (specify)	☐	☐	☐
15f. Is the Clause Effectively Administered?			
YES	☐	☐	☐
NO	☐	☐	☐
If 'NO', explain			

(SIC 315)

15g. In general, what has been the union's position on the adoption of new technologies in your firm? Please explain.

(SIC 315)

16. THE NATURE OF WORKER INVOLVEMENT IN THE PROCESS OF TECHNOLOGY ADOPTION

The following questions are on the nature of the relationship between workers and management in your firm as decisions are made on the adoption of new technology.

16a. Does your firm have a formal mechanism for worker participation in any of the following? Please Check ☑ Yes or No

	YES	NO
• Setting production and/or sales targets:		
- at company level?	☐	☐
- at division/plant level?	☐	☐
- at department/area level?	☐	☐
- at working group level?	☐	☐
• Improving productivity/quality?	☐	☐
• Adoption of new technology?	☐	☐

16b. In your opinion, to what extent and how should management involve workers in decisions regarding the adoption of new technologies. Please comment.

_____
_____
_____
_____
_____
_____

(SIC 315)

17. FUTURE CAPITAL INVESTMENTS

17a. Please indicate how much, **in today's dollars**, your firm plans to spend on **construction of structures and buildings** in ONTARIO over the period **1985 to 1990** and over the period **1991 to 1995**. Record your answer on Chart 17, column 17a.

17b. What percent of this spending can be directly attributed to the adoption of **new technologies**? Record under column 17b.

17c. Would you indicate how much, **in today's dollars**, your firm plans to spend on **machinery and equipment** over the period **1985 to 1990** and over the period **1991 to 1995** in ONTARIO. Record under column 17c.

17d. What percent of this spending on **machinery and equipment** will be for **new technologies**? Record under column 17d.

17e. Please indicate what criterion your firm will likely use to justify the financial investment in the new technologies.

Pay-back period ☐ _____ If Yes, how long?

Return on investment ☐ _____ If Yes, what rate?

Other _____ (specify) ☐ _____ Please elaborate

17f. Considering now your total capital investment in new technology over the next 10 years, what percent will be funded through internal funds and what percent will be funded through external funds?

Internal funds ___%

External funds ___%

100%

(SIC 315)

CHART 17

CAPITAL INVESTMENT PLANS
IN ONTARIO

	INVESTMENT IN STRUCTURES & BUILDINGS		INVESTMENT IN MACHINERY & EQUIPMENT	
	17a	17b	17c	17d
	IN TODAY'S DOLLARS (In Thousands $)	% DIRECTLY RELATED TO NEW TECHNOLOGY	IN TODAY'S DOLLARS (In Thousands $)	% FOR NEW TECHNOLOGY
1985 to 1990?	$_____	_____%	$_____	_____%
1991 to 1995?	$_____	_____%	$_____	_____%

(SIC 315)

18. PLANNING FOR CHANGES IN TECHNOLOGY

These questions ask about your firm's plans for adopting new technologies in ONTARIO.

18a. Does your firm currently have a long-term strategic plan?

Yes ☐ No ☐

18b. Does your firm have a plan to deal with future human resource needs?

Yes ☐ No ☐ If no, go to Question 18d.

18c. Up to what year has your firm planned for its human resource needs?

_____
(WRITE IN YEAR)

18d. Does your firm have a capital investment plan dealing with the adoption of new technologies?

Yes ☐ No ☐ If no, go to Question 19. on p. 25.

18e. Up to what year has your firm planned for its capital requirements?

_____
(WRITE IN YEAR)

18f. On a scale of 1 to 5, please indicate to what extent these two plans (capital investment and human resource plans) are integrated.

(Please circle answer)

NOT AT ALL INTEGRATED 1 2 3 4 5 HIGHLY INTEGRATED

(SIC 315)

19. Please indicate below any other comments on the issue of employment and new technology you wish to make.

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR PARTICIPATION

(SIC 315)

MISCELLANEOUS MACHINERY AND EQUIPMENT INDUSTRY

Number of Firms and Unions Responding by Question

Question		Firms	Unions	Question		Firms	Unions
Question 1	1982-1983	11	0	Question 12	a,b,c,d,e	10	0
	1983-1984	11	0				
	1984-1985	11	0				
	1985-1990	12	1	Question 13		*	*
	1990-1995	12	1				
Question 2		*	*	Question 14	a	12	3
					b	11	2
					c	12	2
Question 3	a,b,c	12	1		d	0	2
Question 4	a,b,c	11	2	Question 15	a	9	3
					b	7	3
					c	*	*
Question 5	a,b,c	11	2		d	8	3
					e	3	1
					f	3	1
Question 6	a,b	11	1		g	7	3
Question 7	a	9	1	Question 16	a	12	3
	b	9	1		b	12	3
Question 8	a	11	0	Question 17	a	12	0
	b	11	0		b	12	0
					c	11	0
					d	12	0
Question 9	a	11	2		e	12	0
	b	11	2		f	12	0
	c	11	2				
				Question 18	a	12	0
Question 10	a,b,c,d,e	10	0		b	12	0
					c	5	0
Question 11	a,b,c,	12	2		d	12	0
	d	12	0		e	8	0
	e	12	0		f	9	0
	f	12	0				

* Data not used and therefore, number of responses not reported.

APPENDIX C

RELIABILITY OF THE SAMPLE

SAMPLE RELIABILITY

The sample reliability is summarized with other sample and population characteristics in "Table 1". The sample was selected as a three stage stratified random sample. The purpose of this stratification was to reduce the error variance in the measurement of organization size by increasing the homogeneity of each group of organizations within each strata.

The first stage consisted in creating two industry sectors (i.e. manufacturing and services). The second stage involved dividing up each industry sector into nine and fourteen industrial sub-classes respectively and according to Standard Industrial Classification codes (see Table 1). The third stage was to further stratify each SIC into three more homogeneous size groups:

Manufacturing Sector	Service Sector
Small 20- 99 employees	20-199 employees
Medium 100-499 employees	200-999 employees
Large 500+ employees	1,000+ employees

Exceptions to these three size groupings are as follows:

SECTOR	ORGANIZATION SIZE EXCLUSION
Manufacturing Sector	
291 Iron & Steel Mills	less than 500
321 Aircraft & Aircraft Parts	less than 50
Service Sector	
701 Banks and Trusts	less than 50
721 General and Life Insurance	less than 50
735 Insurance Brokers	less than 50
909 Federal Government	less than 500
931 Provincial Government	less than 200
951 Local Government	less than 500

Overall, the sample yields a relatively high reliability level in reflecting the employment level of those sectors surveyed. For instance for the Machinery and Equipment Industry the sample yields a minimum confidence level of about 99 percent with an associated allowable error of 5 percent. That is, we would expect that the estimated employment level for the sector has a 99 percent chance of being within $\pm$ 5 percent of the actual employment level found in the frame. Or stated alternatively, if 100 independent random samples were drawn, in 99 of these samples we would expect to have an estimated employment level within $\pm$ 5 percent of the actual employment level found in the sample frame.

TABLE 1: SUMMARY OF MANUFACTURING INDUSTRIES

SAMPLE FRAME AND SAMPLE

Code	SIC NAME	UNIVERSE		SAMPLE FRAME				SAMPLE				
		Number of Firms	Number of[1] Employees	Min. Size Cut Off	Number of Firms	Number of[2] Employees	Share of Universe	Number of Firms	Number of Unions	Number of Employees	Reliability Level (min.)	Allowable Error
											Percent	
1	Iron and Steel Mills	17	41,603	500	7	39,900	96	3	1	21,833	90	23
4	Metal Stamping, Pressing and Coating Industry	185	17,730	20	145	17,200	97	14	3	4,507	99	5
6	Hardware, Tool and Cutlery Manufacturing	225	12,826	20	135	11,500	90	11	6	1,489	94	5
9	Miscellaneous Metal Fabricating Industries	132	12,235	20	110	12,000	98	11	6	2,694	99	5
5	Miscellaneous Machinery and Equipment Manufacturers	304	36,904	20	262	36,500	99	12	3	3,972	99	5
8	Office and Store Machinery Manufacturers	29	10,485	20	29	9,800	93	7	0	11,814	99	5
5	Communications Equipment Manufacturers	67	28,090	20	65	27,800	99	12	2	14,946	90	11
1	Aircraft and Aircraft Parts Manufacturers	22	12,732	50	17	12,000	94	10	5	11,737	95	7
5	Plastic Processing	196	19,218	20	169	18,800	98	13	4	2,400	99	5
								92	28			

Source: Census of Manufacturing, 1982, Statistics Canada, Catalogue No. 31-203.

Rounded to nearest 100.

APPENDIX D

HISTORICAL TABLES

TABLE D.1

MAJOR PRODUCTS OF THE CANADIAN MACHINERY AND EQUIPMENT INDUSTRIES

	VALUE OF SHIPMENTS IN 1981 ($ MILLIONS)	PERCENT OF TOTAL SHIPMENTS
Forestry and Sawmill Machinery	685.7	11.8
Materials Handling Machinery (conveying, elevating, hoisting machinery and industrial trucks)	591.1	10.1
Oil and Gas Field Equipment (includes production and pipeline equipment)	472.6	8.1
Pulp and Paper Machinery	426.8	7.3
Metal Working Machinery (including machine tools)	415.6	7.1
Compressors, pumps, fans and ventilators	374.8	6.4
Mining Equipment	345.5	5.9
Engines, Turbines and Parts (excludes electrical and marine)	273.5	4.7
Mechanical and Hydraulic Power Transmission Equipment and Bearings	268.3	4.6
Other Special Industrial Machinery and Equipment	200.0	3.4
Construction and Maintenance Equipment	183.8	3.2
Other Machinery and Equipment*	1,587.3	27.2
TOTAL	$5,825.0	100.0

* Includes adjustments and estimate for small establishments not reporting in detail.

NOTE: Details may not add to totals due to rounding.

SOURCE: Statistics Canada, Machinery Industries, Cat.No. 42-214, Table 5.

TABLE D.1

A LISTING OF SELECT LARGE MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS IN ONTARIO

COMPANY BY EMPLOYEE SIZE RANGE	PRODUCT LINES
A. COMPANIES WITH 500-999 EMPLOYEES	
Black & Decker Canada Inc.	Power tools, electric chain saws, household products and accessories.
Champion Road Machinery Ltd.	Motor road graders.
Dorr Oliver Canada Ltd.	Mining, pulp and paper, metallurgical, food, pharmaceutical, sewage and water treatment machinery, dewaterers, filter presses, liquids/solids separation equipment.
FAG Bearings Ltd.	Precision instrument bearings, precision ball bearings and water pump shaft assemblies.
Outboard Marine Corp. of Canada Ltd.	Outboard motors, gasoline engines, power lawn mowers, inboard-outboard stemdrive units.
Westinghouse Canada Inc. Corp. Accounting (Turbine & Generator Div.)	Turbines and generators.
B. COMPANIES WITH 200-499 EMPLOYEES	
Allis-Chalmers Canada Inc. (Stephens-Adamson Mfg. Div.)	Conveyors and conveying equipment.
AMCA Heavy Equipment Limited (Provincial Crane Div.)	Cranes.

TABLE D.2 (con't)

COMPANY BY EMPLOYEE SIZE RANGE	PRODUCT LINES
Euclid Canada Limited	Off-highway rear dump trucks.
Ex-Cell-O Corp. of Canada Limited (Specialty Machinery Operations)	Vertical milling and turning machines, numerical control milling, precision boring and grinding, special purpose machines.
F. Jos. Lamb Company (Canada) Ltd.	Custom-designed machinery.
John T. Hepburn Ltd. (Malton Plant)	Structural steel, overhead cranes, hoists, hydraulic presses, steel mill equipment, special machinery, mine hoists, marine equipment, gray iron, ductile and mechanite castings.
Joy Manufacturing Co. (Canada) Ltd.	Air compressors, hoists, drillmobiles, mining hardware, conveyor idlers, electrical connectors, coal machinery, stopers, sheaves, slushers, hand held drills, track drills.
Kenroc Tools Inc. (North Bay Plant)	Tungsten carbide drill bits, DTH bits, snow plow and grader blades, drilling accessories, bit and block assembly, couplings, striking bars.
MTD Products Limited	Power mowers, tools.
Pioneer Chainsaw Corp. Inc.	Chain saws, guide bars, saw chain.
Rexnord (Canada) Ltd. (Mathews Conveyor Div.)	Aggregate and mineral processing equipment.
Richards-Wilcox of Canada Ltd.	Builders hardware, industrial doors, cranes, monorails, overhead material handling equipment.
Rockwell International of Canada Ltd.	Gas and water metres, clamps and couplings.

TABLE D.2 (con't)

COMPANY BY EMPLOYEE SIZE RANGE	PRODUCT LINES
S.A. Armstrong Limited	Hot water heating and engineering specialties, heating-cooling systems, heat exchangers, refrigeration components, general purpose pumps, sump and sewage pumps, solar pumps, hot water circulators, pressure booster systems.
Sheldons Engineering Ltd.	Fans, blowers, exhausters, heating, ventilating, air conditioning apparatus.
Skil Canada Ltd.	Portable electric tools, light construction equipment, gasoline powered hand held chain saws and lawn trimmers electric grass line trimmers.
Valiant Machine & Tool Inc.	Special machinery, automation, fixtures, tools, dies, industrial washers and flushers experimental and prototype work, hydraulic presses, injection and compression molds, electron boom welding.
Wajax Vec Limited	Rubber and urethane screen cloths and trommels, rubber linings, classifier shoes and products for contract mining engineering.
Westinghouse Canada Inc.	Electrical and mechanical apparatus, electronic equipment, nuclear fuels, elevators, escalators, turbines.

TABLE D.3
CENSUS OF ADVANCED TECHNOLOGIES IN CANADA
DISTRIBUTION OF SHOPS WITH ADVANCED MACHINERY IN PLACE

	TOTAL NUMBER OF SHOPS IN CANADA EQUIPPED WITH ONE OR MORE IN 1984	ONTARIO AS A PERCENT OF TOTAL IN 1984
Numerically Controlled Machine Tools	949	63
Computer Assisted Design/Computer Assisted Manufacturing Systems*	105	60
Robotics**	50	66
TOTAL SHOPS WITH ADVANCED MACHINERY	1,104	63
TOTAL ESTABLISHMENTS IN SIC 315 ***	1,301	53

* Twenty of the CAD/CAM systems are located in community colleges and technical institutes.

** Nine of the plants with robotics systems are operated by the auto industry.

*** Data from Statistic Canada's Census of Manufacturers for 1981.

SOURCE: Canadian Machinery and Metalworking, March, 1984, pp. 19, 107 and 112. Statistics Canada, Manufacturing Industries of Canada: National and Provincial Areas, Cat. No. 31-203.

TABLE D.4

MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS (SIC 315)
ONTARIO
1971 - 1984
Current Dollars

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	439	450	463	495	501	502	507	588	646	675	689	717		
CAPACITY UTILIZATION RATE, CANADA	73.4	79.5	85.0	91.4	85.2	79.2	77.2	84.0	94.3	94.5	90.6	69.1	59.1	
OUTPUT ($ Million)														
MANUFACTURING SHIPMENTS	957.3	1,087.3	1,045.6	1,337.4	1,557.6	1,553.8	1,787.4	2,250.1	2,775.9	3,177.8	3,559.6	3,091.9		
MANUFACTURING VALUE ADDED	475.2	480.4	505.8	662.8	753.1	762.3	881.7	1,115.7	1,379.5	1,606.5	1,735.1	1,499.4		
WAGES & SALARIES	280.7	301.3	296.3	361.3	406.4	427.9	479.7	558.7	660.8	769.2	863.0	826.9		
EMPLOYMENT (Number)														
PRODUCTION WORKERS	22,575	22,987	21,722	23,575	25,491	23,557	23,494	26,081	28,635	29,784	28,469	24,514		
ADMINISTRATIVE STAFF	11,163	11,358	10,435	11,245	10,883	11,179	11,535	11,999	11,979	12,933	13,484	12,390		
TOTAL	33,738	34,345	32,157	34,820	36,374	34,736	35,029	38,080	40,614	42,717	41,953	36,904		
CAPITAL INVESTMENT, CANADA ($ Million)														
CONSTRUCTION	7.4	7.5	17.8	20.3	33.2	22.7	18.9	23.8	32.5	50.8	58.9	66.7	19.8	11.3
MACHINERY & EQUIPMENT	28.7	30.4	41.7	55.9	59.4	58.4	55.6	64.4	87.4	130.0	123.1	119.5	90.0	84.7
TOTAL	36.1	37.9	59.5	76.2	92.6	81.1	74.5	88.2	119.9	180.8	182.0	186.2	109.0	96.0
COMPETITIVENESS														
VALUE ADDED/EMPLOYEE (Dollars)	14,084	13,987	15,729	19,035	20,703	21,946	25,171	29,298	33,966	37,609	41,358	40,631		
VALUE ADDED/$ LABOUR	1.69	1.59	1.71	1.83	1.85	1.78	1.84	2.00	2.09	2.09	2.01	1.81		
VALUE ADDED/$ LABOUR (United States)	1.84	1.79	1.98	2.04	2.03	2.06	2.09	2.13	2.16	2.14	2.20	2.14		
EXPORTS ($ Million)	273.0	258.8	337.4	434.7	501.2	517.5	677.0	987.7	1,156.7	1,204.2	1,425.3	1,484.9	1,328.7	
IMPORTS ($ Million)	735.5	864.9	1,116.5	1,420.1	1,586.2	1,575.8	1,801.4	2,192.6	2,851.9	3,330.2	3,701.4	2,721.7	2,892.1	
TRADE BALANCE ($ Million)	(462.5)	(606.2)	(779.1)	(985.4)	(1,085.0)	(1,058.3)	(1,124.4)	(1,284.9)	(1,695.2)	(2,126.1)	(2,276.1)	(1,316.9)	(1,563.3)	
NORMALIZED TRADE BALANCE	(0.459)	(0.539)	(0.536)	(0.531)	(0.520)	(0.506)	(0.454)	(0.414)	(0.423)	(0.469)	(0.444)	(0.319)	(0.370)	

( ) indicates deficit
NOTE: Capacity Utilization Rate shown is for Machinery.

SOURCE: Statistics Canada, MANUFACTURING INDUSTRIES OF CANADA: NATIONAL AND PROVINCIAL AREAS, Cat. No. 31-203; CAPACITY UTILIZATION RATES IN CANADIAN MANUFACTURING, Cat. No. 31-003; and External Trade Division, Special Runs. United States data supplied by Coopers & Lybrand. Calculations by Economics Practice, Currie, Coopers & Lybrand.

TABLE D.5

MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS (SIC 315)
ONTARIO
1971 - 1984
PER CENT CHANGE
Current Dollars

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	2.5	2.9	6.9	1.2	0.2	1.0	16.0	9.9	4.5	2.1	4.1		
OUTPUT ($ Million)													
MANUFACTURING SHIPMENTS	5.2	3.8	27.9	16.5	-0.2	15.0	25.9	23.4	14.5	12.0	-13.1		
MANUFACTURING VALUE ADDED	1.1	5.3	31.0	13.6	1.2	15.7	26.5	23.4	16.5	8.0	-13.6		
WAGES & SALARIES	7.3	-1.7	21.9	12.5	5.3	12.1	16.5	18.3	16.4	12.2	-4.2		
EMPLOYMENT (Number)													
PRODUCTION WORKERS	1.8	-5.5	8.5	8.1	-7.6	-0.3	11.8	9.8	4.0	-4.4	-13.9		
ADMINISTRATIVE STAFF	1.7	-8.1	7.8	-3.2	2.7	3.2	4.8	-0.2	8.0	4.3	-8.1		
TOTAL	1.8	-6.4	8.3	4.5	-4.5	0.8	8.7	6.7	5.2	-1.8	-12.0		
CAPITAL INVESTMENT, CANADA ($ Million)													
CONSTRUCTION	1.4	137.3	14.8	63.5	-31.6	-16.7	25.9	34.6	56.3	15.9	13.2	-71.5	-40.5
MACHINERY & EQUIPMENT	5.9	37.2	34.1	6.3	-1.7	-4.8	15.8	35.7	48.7	-5.3	-2.9	-24.7	-5.9
TOTAL	5.8	57.8	28.1	21.5	-12.4	-8.1	18.4	35.9	50.8	0.7	2.3	-41.5	-11.9
COMPETITIVENESS													
VALUE ADDED/EMPLOYEE	-0.7	12.5	21.8	8.8	6.8	14.7	16.4	15.9	10.7	10.8	-1.8		
EXPORTS	-5.2	30.4	28.8	15.3	3.3	30.8	34.1	27.4	4.1	18.4	-1.4	-5.4	
IMPORTS	17.6	29.1	27.2	11.7	-0.7	14.3	21.7	30.1	16.8	11.1	-26.5	6.3	

SOURCE: Calculated from Table D.4 by Economics Practice, Currie, Coopers & Lybrand. Calculations based on unrounded data where available.

TABLE D.6

MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS (SIC 315)
ONTARIO
1971 - 1984
Constant 1971 Dollars

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	439	450	463	495	501	502	507	588	646	675	689	717		
CAPACITY UTILIZATION RATE, CANADA	73.4	79.5	85.0	91.4	85.2	79.2	77.2	84.0	94.3	94.5	90.6	69.1	59.1	
OUTPUT ($ Million)														
MANUFACTURING SHIPMENTS	957.3	n.a.	n.a.	n.a.	1,067.6	996.1	1,080.0	1,270.5	1,397.8	1,415.5	1,405.9	1,118.6		
MANUFACTURING VALUE ADDED	475.2	479.0	488.2	566.0	552.5	500.5	541.9	621.5	712.9	717.5	697.1	538.6		
WAGES & SALARIES	280.7	289.7	285.5	290.9	296.0	280.1	298.9	323.5	350.2	368.2	369.8	319.5		
EMPLOYMENT (Number)														
PRODUCTION WORKERS	22,575	22,987	21,722	23,575	25,491	23,557	23,494	26,081	28,435	29,784	28,469	24,514		
ADMINISTRATIVE STAFF	11,163	11,358	10,435	11,245	10,883	11,179	11,535	11,999	11,979	12,933	13,484	12,390		
TOTAL	33,738	34,345	32,157	34,820	36,374	34,736	35,029	38,080	40,414	42,717	41,953	36,904		
CAPITAL INVESTMENT, CANADA ($ Million)														
CONSTRUCTION	7.4	7.1	15.6	15.3	22.2	14.3	11.2	13.2	16.4	22.9	23.8	24.6	6.7	3.8
MACHINERY & EQUIPMENT	28.7	29.6	39.0	45.9	42.7	39.8	34.7	36.0	44.4	59.9	50.8	45.7	33.4	29.9
TOTAL	36.1	36.7	54.6	61.2	64.9	54.1	45.9	49.2	60.8	82.8	74.6	70.3	40.1	33.7
COMPETITIVENESS														
VALUE ADDED/EMPLOYEE (Dollars)	14,084	13,945	15,182	16,256	15,189	14,410	15,471	16,322	17,554	16,797	16,616	14,594		

n.a. - Not available. Deflators for 1972 to 1974 are confidential to meet secrecy requirements of the Statistics Act.

NOTE: Calculations based on unrounded data where available. Shipments data deflated by the Industry Selling Price Index for SIC 315; Value Added deflated by the Implicit Price Index for Gross Domestic Product for SIC 315; Wages and Salaries deflated by the Implicit Price Index for Personal Expenditure on Consumer Goods and Services; and Capital Investment deflated by the Implicit Price Indexes for Business Non-Residential Construction and Machinery and Equipment.

SOURCE: Publications as outlined in Table D.4. Also Statistics Canada, INDUSTRY PRICE INDEXES, Cat. No. 62-011; GROSS DOMESTIC PRODUCT BY INDUSTRY, Cat. No. 61-005; and NATIONAL INCOME AND EXPENDITURE ACCOUNTS, Cat. No. 13-201. Calculations and forecast deflators by Economics Practice, Currie, Coopers & Lybrand.

TABLE D.7

MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS (SIC 315)
ONTARIO
1971 - 1984
PER CENT CHANGE
Constant 1971 Dollars

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	2.5	2.9	6.9	1.2	0.2	1.0	16.0	9.9	4.5	2.1	4.1		
OUTPUT ($ Million)													
MANUFACTURING SHIPMENTS	n.a.	n.a.	n.a.	n.a.	-6.9	8.6	17.6	10.0	1.3	-0.7	-20.4		
MANUFACTURING VALUE ADDED	8.8	1.9	15.9	-2.4	-9.4	8.3	14.7	14.7	0.6	-2.8	-22.7		
WAGES & SALARIES	3.2	-8.4	9.6	1.8	-2.7	3.7	8.2	8.3	5.1	0.4	-13.6		
EMPLOYMENT (Number)													
PRODUCTION WORKERS	1.8	-5.5	8.5	8.1	-7.6	-0.3	11.0	9.8	4.0	-4.4	-13.9		
ADMINISTRATIVE STAFF	1.7	-8.1	7.8	-3.2	2.7	3.2	4.0	-0.2	8.0	4.3	-8.1		
TOTAL	1.8	-6.4	8.3	4.5	-4.5	0.8	8.7	6.7	5.2	-1.8	-12.8		
CAPITAL INVESTMENT, CANADA ($ Million)													
CONSTRUCTION	-4.1	119.7	-1.9	45.1	-35.6	-21.7	17.9	24.2	39.6	3.9	3.4	-72.8	-43.3
MACHINERY & EQUIPMENT	3.1	31.8	17.7	-7.0	-6.8	-12.8	3.7	23.3	34.9	-15.2	-10.8	-26.9	-10.5
TOTAL	1.7	48.8	12.1	6.8	-16.6	-15.2	7.2	23.6	36.2	-9.9	-5.8	-43.0	-16.0
COMPETITIVENESS													
VALUE ADDED/EMPLOYEE	-1.8	8.9	7.1	-6.6	-5.1	7.6	5.5	7.5	-4.3	-1.1	-12.2		

n.a. - Not available.

SOURCE: Calculated from Table D.6 by Economics Practice, Currie, Coopers & Lybrand. Calculations based on unrounded data where available.

TABLE D.8

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY RELATIVE STRENGTH

		NUMBER OF EMPLOYEES 1981	AVERAGE ANNUAL RATE OF CHANGE PERCENT, 1971-1981
I.	TOTAL INDUSTRY	41,810	3.5
II.	TWO DIGIT LEVEL		
	MATERIAL HANDLING AND RELATED	950	1.6
	MACHINING AND RELATED	12,000	3.1
	PRODUCT FABRICATING, ASSEMBLING AND REPAIRING	7,985	3.8
	NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	3,355	4.8
	PROCESSING	1,370	6.6
	MANAGERIAL, ADMINISTRATIVE AND RELATED	4,085	9.2
II.	FOUR DIGIT LEVEL		
	MATERIAL HANDLING AND RELATED		
	Hoisting, n.e.c.	190	(1.2)
	Packaging, n.e.c.	190	0.0
	Material-Handling Equipment Operators, n.e.c.	305	5.4
	Other Material Handling and Related	115	5.9
	TOTAL	950	1.6
	MACHINING AND RELATED		
	Machine-Tool Operating	1,735	(2.3)
	Filing, Grinding, Buffing, Cleaning and Polishing	445	(0.4)
	Metalworking - Machine Operators, n.e.c.	550	0.9
	Foremen, Metal Machining	410	0.9
	Foremen, Metal Shaping and Forming	250	3.6
	Welding and Flame Cutting	3,300	4.7
	Tool- and Die-Making	920	5.5
	Inspecting and Testing, Metal Machining	195	6.4
	Machinist and Machine-Tool Setting-Up	3,225	6.7
	Sheet-Metal Workers	520	8.0
	TOTAL	12,000	3.1

TABLE D.8 (con't)

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY RELATIVE STRENGTH

	NUMBER OF EMPLOYEES 1981	AVERAGE ANNUAL RATE OF CHANGE PERCENT, 1971-1981
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING		
Motor Vehicle Mechanics and Repairmen	125	(3.8)
Other Mechanics and Repairmen, n.e.c.	145	(1.0)
Other Fabricating and Assembling, Metal Products	585	(0.7)
Motor Vehicle Fabricating and Assembling	275	1.0
Industrial, Farm and Construction Machinery Mechanics and Repairmen	985	1.9
Engine and Related Equipment Fabricating and Assembling, n.e.c.	230	1.9
Other Product Fabricating, Assembling and Repairing	210	2.1
Electrical Equipment Fabricating and Assembling	440	2.8
Foremen: Mechanics and Repairmen, n.e.c.	170	6.6
Inspecting and Testing, Fabricating and Assembling, Metal Products	495	8.2
Painting and Decorating, Except Construction	420	8.8
Industrial, Farm, Construction and Other Mechanized Equipment and Machinery Fabricating and Assembling	1,510	8.9
Foremen, Fabricating and Assembling, Metal Products, n.e.c.	960	9.0
Electrical and Related Equipment Installing and Repairing, n.e.c.	250	12.1
Occupations in Labouring and Other Elemental Work, Fabricating and Assembling Metal Products, n.e.c.	270	12.9
TOTAL	7,985	3.8

TABLE D.8 (con't)

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY RELATIVE STRENGTH

	NUMBER OF EMPLOYEES	AVERAGE ANNUAL RATE OF CHANGE PERCENT, 1971-1981
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS		
Draughtsman	900	2.6
Industrial Engineers	530	3.9
Mechanical Engineers	835	5.2
Systems Analysts, Computer Programmers and Related	180	9.1
Architectural and Engineering Technologists and Technicians	510	10.1
Supervisors, Other Occupations in Architecture and Engineering	115	14.4
TOTAL	3,355	4.8
PROCESSING		
Moulding, Coremaking and Metal Casting	220	2.0
Metal Heat-Treating	120	3.5
Foremen, Metal Processing and Related	115	6.7
Metal Processing and Related, n.e.c.	520	17.9
TOTAL	1,370	6.6
MANAGERIAL, ADMINISTRATIVE AND RELATED		
Occupations Related to Management and Administration, n.e.c.	170	(3.2)
General Managers and Other Senior Officials	360	2.5
Purchasing Officers and Buyers, Except Wholesale and Retail Trade	315	3.2
Accountants, Auditors and Other Financial Officers	745	7.5
Purchasing Management	205	11.3
Other Managers and Administrators, n.e.c.	410	14.6
Sales and Advertising Management	605	17.1
Production Management	705	18.9
Personnel and Industrial Relations Management	135	24.6
Financial Management	145	25.5
Management: Natural Sciences, Engineering and Mathematics	190	28.9
TOTAL	4,085	9.2

( ) Indicates decline
NOTE: Details do not add to totals as all occupations are not included.
SOURCE: Census data, Ontario Ministry of Labour

TABLE D.9

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
I. TOTAL INDUSTRY	7,065	13.9	16.9	2,975
II. TWO DIGIT LEVEL				
PROCESSING	35	5.6	2.6	(5)
MATERIAL HANDLING AND RELATED	130	13.0	13.7	25
MACHINING AND RELATED	385	3.5	3.2	75
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	155	1.7	4.6	120
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING	870	9.8	10.9	330
MANAGERIAL, ADMINISTRATIVE AND RELATED	620	7.1	15.2	500
III. FOUR DIGIT LEVEL				
PROCESSING				
Metal Processing and Related, n.e.c.	0	10.0	0.0	(10)
Foremen, Metal Processing and Related	0	0.0	0.0	0
Metal Heat-Treating	0	0.0	0.0	0
Moulding, Coremaking and Metal Casting	15	5.6	6.8	5
TOTAL	35	5.6	2.6	(5)
MATERIAL HANDLING AND RELATED				
Packaging, n.e.c.	95	55.3	50.0	(10)
Other Material-Handling and Related, n.e.c.	5	0.0	4.3	5
Material-Handling Equipment Operators	10	0.0	3.3	10
Hoisting, n.e.c.	15	0.0	7.9	15
TOTAL	130	13.0	13.7	25

TABLE D.9 (con't)

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
MACHINING AND RELATED				
Machine-Tool Operating	65	4.8	3.7	(40)
Machinist and Machine-Tool Setting-Up	25	1.8	0.8	(5)
Metalworking-Machine Operators	50	10.9	9.1	(5)
Filing, Grinding, Buffing, Cleaning and Polishing, n.e.c.	10	3.2	2.2	(5)
Foremen, Metal Machining Operations	10	1.3	2.4	5
Foremen, Metal-Shaping and Forming, Except Machining	5	0.0	2.0	5
Sheet-Metal Workers	5	0.0	1.0	5
Inspecting and Testing, Metal Machining	20	9.5	10.3	10
Welding and Flame Cutting	60	0.7	1.8	45
Tool-and Die-Making	115	4.6	12.5	90
TOTAL	385	3.5	3.2	75
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS				
Supervisors, Other Occupations in Architecture and Engineering	0	0.0	0.0	0
Architectural and Engineering Technologists and Technicians	20	2.6	3.9	15
Industrial Engineers	20	0.0	3.8	20
Systems Analysts, Computer Programmers and Related	25	6.7	13.9	20
Mechanical Engineers	30	1.0	3.6	25
Draughtsmen	55	2.9	6.1	35
TOTAL	155	1.7	4.6	120

TABLE D.9 (con't)

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING				
Other Product Fabricating, Assembling and Repairing, n.e.c.	15	20.6	7.1	(20)
Motor Vehicle Fabricating and Assembling, n.e.c.	20	12.0	7.3	(10)
Painting and Decorating, Except Construction	0	2.8	0.0	(5)
Electrical and Related Equipment Installing and Repairing, n.e.c.	0	0.0	0.0	0
Motor Vehicle Mechanics and Repairmen	0	0.0	0.0	0
Other Mechanics and Repairmen, n.e.c.	5	3.1	3.4	0
Engine and Related Equipment Fabricating and Assembling, n.e.c.	35	15.8	15.2	5
Foremen, Mechanics and Repairmen, n.e.c.	5	0.0	2.9	5
Foremen, Fabricating and Assembling, Metal Products, n.e.c	15	0.0	1.6	15
Industrial, Farm and Construction Machinery Mechanics and Repairmen	20	0.6	2.0	15
Other Fabricating and Assembling, Metal Products, n.e.c.	90	11.2	15.4	20
Electrical Equipment Fabricating and Assembling	145	35.8	33.0	25
Labouring and Other Elemental Work, Fabricating and Assembling Metal Products, n.e.c.	50	6.3	18.5	45
Inspecting and Testing, Fabricating and Assembling, Metal Products, n.e.c.	145	24.4	29.3	90
Industrial, Farm, Construction and Other Mechanized Equipment and Machinery Fabricating and Assembling, n.e.c.	145	7.0	9.6	100
TOTAL	870	9.8	10.9	330

TABLE D.9 (con't)

OCCUPATIONAL INDICATORS: MISCELLANEOUS MACHINERY AND EQUIPMENT MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
MANAGERIAL, ADMINISTRATIVE AND RELATED				
General Managers and Other Senior Officials	0	0.0	0.0	0
Management: Natural Sciences, Engineering and Mathematics	5	0.0	2.6	5
Production Management	5	0.0	0.7	5
Occupations Related to Management and Administration, n.e.c.	30	6.4	17.6	15
Purchasing Management	25	7.1	12.2	20
Personnel and Industrial Relations Management	30	0.0	22.2	30
Financial Management	35	0.0	24.1	35
Sales and Advertising Management	40	0.0	6.6	40
Purchasing Officers and Buyers, Except Wholesale and Retail Trade	90	4.3	28.6	80
Other Managers and Administrators, n.e.c.	175	47.6	42.7	125
Accountants, Auditors and Other Financial Officers	175	6.9	23.5	150
TOTAL	620	7.1	15.2	500

() Indicates decline.

NOTE: Females employed in 1981 is calculated from percent of total.
Details do not add to totals as all occupations are not included.

SOURCE: Census data, Ontario Ministry of Labour.

FINAL REPORT AND APPENDICES OF THE ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

Final Report — Employment and New Technology

Appendices:

1. Labour Market Trends in Ontario, 1950-1980
2. Occupational Employment Trends in Ontario, 1971-1981
3. Emerging New Technology, 1985-95: Framework for a Survey of Firms
4. Employment and New Technology in Ontario's Manufacturing Sector: A Summary of Selected Industries
5. Employment and New Technology in the Iron and Steel Industry
6. Employment and New Technology in the Metal Fabricating Industry
7. Employment and New Technology in the Machinery and Equipment Industry
8. Employment and New Technology in the Aircraft and Aircraft Parts Industry
9. Employment and New Technology in the Communications Equipment Industry
10. Employment and New Technology in the Office, Store and Business Machine Industry
11. Employment and New Technology in the Plastic Processing Industry
12. Employment and New Technology in Ontario's Service Sector: A Summary of Selected Industries
13. Employment and New Technology in the Chartered Banks and Trust Industry
14. Employment and New Technology in the Insurance Industry
15. Employment and New Technology in the Government Services Industry
16. Employment and New Technology in the Telecommunications Industry
17. Employment and New Technology in the Retail Trade Industry
18. Employment and New Technology in the Computer Services and Management Consulting Industry
19. Industry-Sector and Occupational Employment in Ontario, 1985-1995
20. Technological Change, Productivity, and Employment: Studies of the Overall Economy